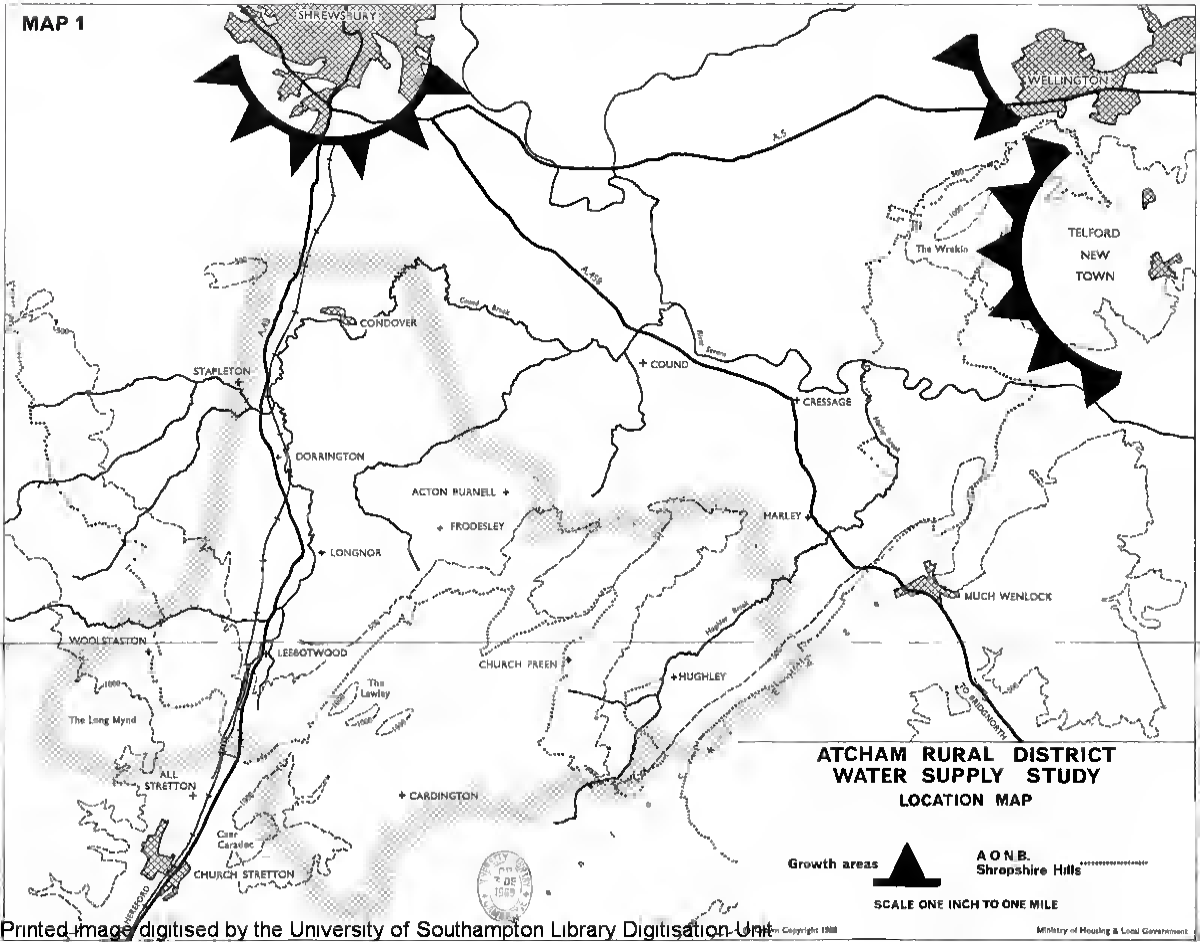
MAP 1



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1. Introduction

1.1.1 Official water supply policy in recent years has been, as stated in the 1944 White Paper, *A National Water Policy*,[1] '. . . to ensure that as many houses as possible can readily be connected with a public main and that the householders can obtain ample and wholesome water from the mains supply'. Attainment of this goal in the case of rural localities has been hampered by the high cost of laying mains and pipes, relative to the cost of supplying urban communities, but extension of rural supplies has been encouraged by the Rural Water Supplies and Sewerage Acts, 1944–66. These provide that contributions towards certain rural water supply and main drainage schemes should be made both by the central government and by the appropriate county council. This legislation has been instrumental in reducing the proportion of households in rural districts of England and Wales not served by a piped supply from about 30% in 1944 to 3% today. However, recent experience has shown that as such supplies are extended, successive projects become more and more costly, for the areas concerned become more remote and the properties in them less accessible.

1.1.2 The question has therefore arisen as to whether or not it is time to call a halt to the extension of mains supplies to rural districts. But at what stage can it be asserted that a scheme is in any sense too expensive? The formulation of criteria that might be employed to arrive at such a decision, and the assembly of the necessary data, is the subject of cost-benefit analysis. This technique is severely limited in its applicability to many public expenditure decisions, mainly because of the difficulties encountered in quantifying benefits. This study will show that under certain assumptions it is possible to measure not only the costs of a rural water supply project, but also the benefits that are likely to accrue from it.

1.1.3 The object of the present exercise is, in fact, to derive procedural rules that are of general application to the appraisal of rural water supply projects. As a pilot study, the proposed South Atcham scheme of the West Shropshire Water Board (W.S.W.B.) was selected for analysis. Specifically, the aim was to determine whether it could be shown that it was advantageous to go ahead with this particular scheme, or of certain parts of it, or whether the social objectives lying behind the provision of piped water supplies in this area might not be better achieved by other means.

1.1.4 Although the South Atcham scheme originally caused concern at the centre because of the large Treasury grants similar projects had involved in the past, our investigation of the costs and benefits associated with the scheme covers much wider ground. Thus, to quote a well-known U.S. precedent, in estimating the value of any particular public project, we should be concerned not only with the benefits to any particular group or organisation, but all benefits 'to whomsoever they may accrue'.[2] In the following pages we will

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[1] *A National Water Policy*, Cmd. 6515, H.M.S.O., 1944.
[2] Flood Control Act 1936, Section I.

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sometimes refer to such benefits as 'social' benefits, since by definition a gain to any member of society is at once a social gain.[1] *Mutatis mutandis*, the same applies to costs. We are therefore mainly concerned with calculations of aggregate benefits and costs, and are less interested in whether, for example, a cost is incurred by the Treasury, by a county council, a rural district council, a water undertaking or by a private individual. All expenditures involving the use of scarce economic resources (i.e. those which have value in alternative uses) are included in our social cost calculations: by the same token, costs which do not involve the use of economic resources, and are merely transfer payments, are not. On the other hand, as a subsidiary exercise, an attempt is made to identify the costs which are borne (in an accounting sense) by public authorities of one form or another, since we are also interested in the budgetary implications of the study.

1.1.5 Similarly, the study is by no means concerned solely with water supply; in fact, a wide range of activity in both public and private spheres is investigated. Nevertheless, it should be borne in mind that the initial stimulus for the inquiry was created by water undertakings' applications for financial assistance for rural projects and that the assumptions that are to be specified regarding the need for statutory water undertakings to provide potable supplies to all households are fundamental to the whole exercise.

[1] This does not rule out the possibility that a gain to X may be offset to a greater or lesser degree by a loss to Y, which should also be included in the calculation if it is a 'technological' as opposed to a merely 'pecuniary' external effect.

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2. The South Atcham Scheme

2.1. Characteristics of the Area

2.1.1 The scheme planned by the W.S.W.B. is for the extension of mains supplies mainly in the parishes of Condover (part), Longnor, Leebotwood, Frodesley, Acton Burnell, All Stretton (part), Woolstaston, Cardington, Church Preen, Ruckley and Langley, Hughley, and Kenley. The parishes listed are all within the area of the Atcham (Shropshire) R.D.C. and the scheme is intended to serve an area of approximately 42 square miles. Occupiers of some 600 properties would be potential beneficiaries of the scheme.

2.1.2 The study area is close to the Borough of Shrewsbury, the centre of which is about three miles due north of its northernmost point (see Map 1). In the north-east the boundary is about five miles from the designated New Town of Telford. The population of Shrewsbury, currently 53,000, is expected to be about 65,000 by 1981; up till recently, Dawley (Telford) was expected to increase in size from its present population of 21,000 to some 90,000 in about 25 years, but the Minister of Housing and Local Government has now made a draft order extending the designated area of Telford to the north with a proposed total intake of 100,000 people by the late 1980s.

2.1.3 This suggests that the South Atcham scheme may not be a typical example of the sort of rural water supply project that has latterly caused concern at the centre, for compared with most areas as yet unserved with mains supplies, the South Atcham area is by no means remote. Moreover, apart from its proximity to two expanding urban areas, the remoteness of the area is still further reduced by the existence of a major transport route, the A49 from Shrewsbury to Hereford and Ross-on-Wye, which runs through the area from north to south and which it is proposed eventually to convert into a dual carriageway road. Until recently, the area was also served by the rail route between Shrewsbury and South Wales, but the stations at Leebotwood, Dorrington and Condover, the only ones existing in the area, have now been closed down.

2.1.4 The southern part of the study area is within the Shropshire Hills Area of Outstanding Natural Beauty. This designation, intended for the protection of the natural landscape, and the tourist attraction implied by landscape of this quality, is a feature which the study area probably does have in common with other more remote areas of the British Isles, as yet not reached by mains supplies.

2.1.5 In general terms, three physical sub-areas may be distinguished within the area:—

(i) broadly, the parishes of Condover, Frodesley, Acton Burnell and part of Longnor. This area, drained by the Cound Brook and its tributaries, is part of the mid-Shropshire section of the Severn Valley and is gently undulating lowland country, about 200–400 feet A.O.D.

(ii) the parishes of All Stretton, Woolstaston, the western part of Cardington and the southern part of Longnor. At about 500 feet A.O.D., the northern

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lowland area begins to merge with the South Shropshire hills. This area includes the northern slopes of the Long Mynd and part of the group of hills including Caer Caradoc and The Lawley. Some moorland above 1,000 feet A.O.D. is included.

(iii) the parishes of Kenley, Hughley, Church Preen, and Ruckley and Langley, with parts of Cardington and Acton Burnell. This area lies between The Lawley and Wenlock Edge. Its topography is more varied, including undulating land up to about 800 feet, as well as the valleys of the Hughley and Harley Brooks.

2.1.6 In the study area as a whole, perhaps the most significant physical characteristic is the rapid transition over a very short distance from lowland country typical of much of Lowland Britain, to foothills and moorland showing the characteristics of a good deal of more remote Highland Britain. In other words, although the South Atcham scheme as a whole may not be typical of schemes which may in future be submitted to the Ministry of Housing and Local Government for assistance under the Rural Water Supplies and Sewerage Acts, certain parts of it may be very typical.

2.2. The Water Supply Scheme

2.2.1 The planned scheme is outlined on Map 2,[1] on which are distinguished proposed pumping and distribution mains and existing Water Board mains that would be retained should the scheme proceed. The major part of the scheme is for an additional borehole to be sunk at Condover, from which water would be pumped almost 4½ miles in a south-easterly direction to a service reservoir, situated near Frodesley. This would have a top water level of 585 A.O.D. From here water would flow, by gravity, back to the villages of Condover, Dorrington and Ryton, as well as to Acton Burnell, Leebotwood and Longnor.

2.2.2 From Leebotwood, water would be boosted about 1½ miles eastwards to a service reservoir west of Woolstaston village, which is at 900 feet A.O.D. Another booster would pump water from the Frodesley reservoir in a south-easterly direction to Lodgehill reservoir, about a mile away, and situated at approximately 850 feet A.O.D. From here, water would flow by gravity to the villages and hamlets of Ruckley, Church Preen, Plaish and Cardington. Some of this would require still further boosting; a booster at Lower Chatwall would pump water in a south-westerly direction to Enchmarsh and Willstone and eastwards to Broome and High Fields.

2.2.3 The remaining part of the scheme is quite distinct; a new borehole would be sunk at Uckington, which is itself well outside the study area, being about six miles north of the village of Kenley. From Uckington, water would have to be pumped through existing mains to a reservoir at Bull Farm, Kenley, from which it would be pumped westwards to Ballsbill Coppice (750 feet A.O.D.), which is about a mile south-east of Acton Burnell village. From this reservoir water could flow by gravity to Kenley and Hughley and, in a south-westerly

[1] Ignore for the moment the division into the four areas A, B, C and D, shown on Map 2.

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direction, to serve scattered properties in the eastern portion of Cardington parish. The main between Uckington and the study area would not pass through any areas as yet unserved with mains supplies. No benefits would therefore be derived by consumers outside the designated study area.[1]

2.2.4 Map 2 shows that W.S.W.B. mains already exist in parts of the northern portion of the study area. The water for this area at present comes from the west, through Stapleton, from the Ford pumping station; it is, however, intended that this source should be superseded in this particular area by the Condover supply. Water Board mains already exist in Acton Burnell and Cardington villages as well; although these would continue to be used if the scheme went ahead, the actual supplies to these villages are also planned to be replaced by the new source. The remainder of the study area is served by a variety of sources; individual boreholes, shallow wells, brooks, springs and several community sources of varying degrees of quality. These are examined more fully in the next chapter.

[1] A preliminary plan, existing at the commencement of this study, but since abandoned, indicated that the eastern parishes would also be supplied from the Condover source, hence their inclusion in the study area.

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3. The 'Do Nothing' Solution

3.1. Introduction

3.1.1 We now examine a fundamental issue, namely, whether a feasible alternative to the provision of piped water supplies for rural properties might merely be to leave things as they are and to allow people to continue to obtain their supplies from private sources. This would clearly not be in accordance with the principles which have governed the water supply industry in recent years, as is evidenced by our opening quotation from the 1944 White Paper and by the provisions of the Rural Water Supplies and Sewerage Acts. However, we question the validity of this attitude and suggest that the first object should be to determine precisely what the benefits of a rural water supply scheme are, and to measure these against the costs of that scheme. This chapter is mainly concerned with the question of benefits, and for this purpose it is convenient to examine the 'do nothing' approach under three headings, (a) Domestic Use, (b) Commercial and Industrial Use, and (c) Fire Fighting.

3.1.2 Before doing so, however, one general point should be made. This is that we cannot directly test the willingness of consumers in the area to pay for the mains service and use this as an indication of its value to the community concerned or, therefore, as a direct measure of benefit. The reason for this is that the mains service (as opposed to individual connections to the main) cannot be sold to individuals; it is in joint supply to those individuals, in that if a mains service is provided for A it also is for B, whether the latter wants it or not. The market therefore provides no direct guide for the investment decision because the mains system is not provided exclusively for any one individual, and there is no incentive for a potential consumer to reveal the value he would place upon the service.

3.1.3 Moreover, it is doubtful whether the experience of *other* water undertakings can be used as a guide to the value placed upon mains supplies by consumers. This can be shown to be the case even if the temporary assumption is made that consumers in our area and consumers in the area already in receipt of mains supplies are homogeneous in respect of their effective demand for piped water. This can be illustrated as follows.

3.1.4 Connection to the mains involves the consumer not only in an immediate payment, but also a commitment to an annual payment to the water undertaking (i.e. the water rate). It can therefore be said that for any property owner in an area already served with mains supplies, the *minimum* present worth to him of being connected to the mains will be equal to:—

$$\sum_{t=o}^{n} \frac{R_t}{(1+r)^t} + K \qquad (3.1)$$

where R_t = the annual water rate (or cost of water to a metered consumer),
K = connection cost (if applicable),

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r = the consumer's subjective rate of discount,
n = the length of life of the property concerned.
(An arbitrary cut-off point of 30 years is assumed throughout this study.)

We now turn to the cost of the proposed scheme. This will be:—

$$\sum_{t=o}^{n} \frac{O'_t}{(1+r)^t} + K' + M' \qquad (3.2)$$

where O'_t = annual running cost of the new scheme,
K' = cost of connecting to the new scheme, and
M' = capital costs of the scheme, other than connection costs.

3.1.5 Retaining the assumption of consumer homogeneity, if (3.1) > (3.2), calculated on a per household basis, we can say that the market reveals that it places a value on the scheme that is higher than its costs. Unfortunately, however, (3.1) is a strictly minimum evaluation, and there are reasons to believe that the present worth of the cost per household of any rural scheme of the sort that is currently being considered will be greatly in excess of the present value of water charges paid by consumers in any area of the country.

3.1.6 The rationale behind the present study is that the cost of water supply per household in a rural area is greater than in urban areas. In view of this we are, *prima facie*, justified in assuming, should we choose an urban area as the one for comparison, that the value of (3.1) would be considerably less than that of (3.2). The assumption therefore is that $O_t + M_t + K_t$ (operating, capital and connection costs of the *existing* scheme) $< O'_t + M'_t + K'_t$. The reason for this is that $R_t \simeq O_t + M_t$, where M_t is expressed as an annual flow (i.e. the policy of urban water undertakings is, in general, to break even, and also to keep charges to various classes of consumer broadly in line), and we would expect the sum of operating, capital and connection costs per household to be higher in rural than in urban areas. We are therefore unlikely to obtain relevant information for the rural investment decision from urban experience.

3.1.7 Even if another rural area were selected, difficulties would be encountered. First of all, as we have seen, rural water supply projects are heavily subsidised by the central government and the appropriate county authority, and many rural water undertakings are subsidised from the general rate fund of the local authority concerned. Secondly, the cost of any individual rural scheme will be shared among all consumers of that water undertaking's area, for the practice is to maintain a common charge throughout the area of supply.[1] Urban-rural subsidisation in the water supply field can therefore be expected to occur on a fairly extensive scale and it is difficult to conceive of a situation in which consumers in remote rural districts ever pay the full cost their consumption entails. At all events, if we were to observe an area in which consumers revealed that they valued piped supplies to the extent of the cost of the South Atcham scheme,

[1] Regional variability of charges within undertakings' areas appears to be restricted to newly amalgamated areas, as a temporary policy.

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they would have to be paying an annual sum of approximately £107 per property for water;[1] we have no knowledge of an area similar to South Atcham in which anything approaching such a rate is paid. Inflation, too, makes it difficult to use the experience of areas already in receipt of water supplies as a guide to willingness to pay.

3.1.8 This brings us to the next point, which is the relaxation of the homogeneity assumption. Heavy industrial consumption could certainly produce a revenue figure per property above the sum quoted, but this would give us no help at all in estimating the value of the water supply scheme to consumers of the sort to be found in South Atcham. But even if we *could* isolate the minimum value placed upon water by householders and farmers inhabiting properties similar in value and other respects to those in the study area, and even if this minimum value *was* higher than the cost of the scheme, it would still have to be established that the situations were comparable in that the quality and availability of the alternative private sources of supply were also found to be homogeneous.

3.2. Domestic Water Use

3.2.1 We have shown that the market is unlikely to reveal the value placed upon a rural water supply scheme by potential consumers, but even if it did, it is doubtful whether the resulting figure would, given the distribution of income, have any normative significance for society as a whole. As a general principle, such a situation could be explained by two things:—

(a) individuals may not be the best judge of their own welfare in a particular case, for they may not be in possession of all the relevant facts. (Accordingly, a rise in property values subsequent to connection to mains supplies may not adequately reflect the true gain to the individuals concerned), or

(b) there may be 'external' effects; i.e. a divergence between the private and social costs and benefits of a project. In the present context, the actual consumption of potable water (as distinct from the provision of mains) by X may be to the advantage of Y, but X would not take this into account in his private market decisions.

3.2.2 As we shall show, there is some evidence to suggest that even if true preferences were revealed, the market might fail to bring about a socially optimal solution for the above reasons, the link between them largely being considerations of public health.

3.2.3 Since individuals already obtain *some* water, the important comparison to be made is between the value of existing supplies and the value of those which would be provided by a statutory water undertaking. The important difference between the two sources is mainly one of water *quality* (although quantity,

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[1] This is based upon an initial capital cost (K) of approximately £1,200 per property and estimated as an annual equivalent sum (a) over 30 years (n) at 8% (r) according to the formula

$$a = \frac{Kr\,(1+r)^n}{(1+r)^n - 1}$$

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particularly in dry periods, is sometimes an important consideration).[1] This raises the question of public health, and the dangers thereto of the continuance of the consumption of water from private sources of supply.

3.2.4 In the particular instance of South Atcham, the advice of the Chief Public Health Inspector of the Atcham R.D.C. was obtained. He clearly illustrated the inadequacy of water supplies in the area from the point of view of a public health authority. There are basically three categories of supply in the area which can usefully be distinguished:–

(a) *West Shropshire Water Board Supplies*

3.2.5

As already indicated, the northern part of the study area is partly served by the W.S.W.B.; the supplies are adequate and satisfactory. The village of Cardington is served by a private borehole constructed jointly by the County Council, in connection with the school, and public subscription by villagers. The system has been taken over by the Water Board, who have extended it to include houses slightly outside the perimeter of the village. The bacteriological quality is stated as being very good, but the Water Engineer is not satisfied with this source of supply: it is, he feels, being used to capacity, and no more properties should be connected to the mains until the supply is replaced by the Condover scheme. Moreover, he feels that the source is too shallow to be absolutely safe.

3.2.6 Although the village of Acton Burnell is served by Water Board mains, the reservoir at Bull Farm, Kenley, which is intended to serve the village, is of insufficient elevation to serve its higher reaches. This, too, will be replaced by the Condover source. The only other Water Board supply in the area is at Church Preen. This is a borehole which was originally constructed for the use of six council houses and has since been adopted by the Water Board. Its bacteriological quality is unsatisfactory.

3.2.7 An interesting point in this context is that our investigation revealed that many households in the northern area, already extensively served by Water Board mains, have not bothered to connect to the mains, even though, in some cases, the main goes right past the front door. The implications of this are discussed below.[2]

(b) *Community Supplies*

3.2.8

There are a number of supplies organised privately by groups of property owners and by individual villages, which vary considerably in quality. Thus, until the installation of a mains supply, the village of Dorrington was entirely served by the Netley estate supply; even today this continues to serve a large number of properties in the Dorrington district, although it has proved to be bacteriologically unreliable for years. The village of Longnor, and several outlying farmsteads and cottages, are supplied by an estate water scheme which has been in operation for many years. The source of this supply is a collection of springs,

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[1] We are not considering the *convenience* of having water supplies piped into the home, for about 75% of the households in the study area that currently use private sources already have this water piped into the house.

[2] Paragraphs 6.3.1 to 6.3.7.

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and as the bacteriological quality of this water varies during the year from satisfactory to grossly polluted, the Atcham R.D.C. Public Health Department carries out chlorination of the supply as a precautionary measure.

3.2.9 The village of Leebotwood is served by an old scheme originally installed by the Salop County Council to provide water for smallholdings in the village, and although the system was not designed for widespread use, the County Council, over the years, has afforded a supply to other private property owners in the village and surroundings. The pipework of the system is inadequate and has given considerable trouble, because of corrosion, at various times, resulting in an intermittent supply. The County Council is believed to be anxious to be relieved of the responsibility for water supply to the village, and the bacteriological quality of the water is not up to the standard the public health authorities would like.

3.2.10 A group of farmers in the Frodesley area have combined to construct a borehole which serves several farms, cottages and private houses. Its bacteriological quality leaves something to be desired. In addition, the County Council has provided a spring supply, the quality of which is unsatisfactory, to serve several smallholdings in the parish.

3.2.11 Apart from the inadequate Water Board supply, the village of Acton Burnell is also served by an old estate supply, but this is bacteriologically unreliable, and the estate owner is anxious to terminate his responsibility in this direction as soon as possible. The parish of Ruckley and Langley is very small and has no communal water supply apart from a spring, piped to a small reservoir, which supplies a small group of cottages in Ruckley village. The bacteriological quality of this, too, is unsatisfactory.

3.2.12 There are two estate supplies in existence in the parish of Kenley, and both of them are grossly polluted. Several newcomers to the parish who have purchased houses from the estate have installed boreholes to meet the Council's requirements. The village of Hughley is largely served by a borehole which has been constructed jointly by the residents of the village, and which remains a completely private venture. The bacteriological quality of this water is satisfactory. Church Preen parish is widely dispersed, the only common water supply in existence being the borehole, already referred to as being taken over by the Water Board and which is unsatisfactory. The hamlet of Plaish, within Cardington parish, is served by a private spring supply piped via a reservoir; its bacteriological quality is unreliable. Apart from Cardington village itself, the remainder of the properties in the parish rely upon individual sources of supply.

(c) *Individual Private Supplies*

3.2.13

Houses in the study area outside the scope of the supplies referred to above are served by boreholes, shallow wells and springs, and the Atcham R.D.C. Public Health Department estimates 65% of these to be bacteriologically unsatisfactory.

Public Health Implications

3.2.14

The general picture regarding the bacteriological quality of private supplies in the area is therefore clear, and in the light of the foregoing information, the

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County Medical Officer of Health was approached for his views concerning the public health implications of such a situation. He was asked whether in fact the use of polluted supplies in the area did have an adverse effect on people's health. Unfortunately, no statistical evidence to substantiate or deny this was available, although no specific outbreaks of waterborne disease in the area were known of. On the other hand, the view appeared to be that the assumed greater risk of a future waterborne epidemic should private, rather than Water Board, supplies continue to be consumed, was enough to justify the general support of a public health authority for a rural water supply scheme. Much the same attitude was taken by two local general practitioners who were consulted.

3.2.15 We were able, therefore, to obtain little more than a reiteration of general public health principles on the subject, and could obtain no statistical evidence regarding the probability that individual illness or an epidemic of some sort might originate from the use of existing supplies. We are merely left with the vague notion that there is *some* risk: what that risk is in statistical terms remains unknown.

3.2.16 What of the private supplies, such as the Hughley community supply, that were stated by the Atcham R.D.C. to be satisfactory? The general County view is that 'Although it is possible to obtain satisfactory samples from these sources, in practice it is found that if a sufficient number of samples is taken at all seasons, it is practically certain that some of the samples will be bacteriologically unsatisfactory and, therefore, even if one sample is unsatisfactory from a public health point of view, one is unable to agree that the source is satisfactory'.

3.2.17 The Atcham R.D.C. evidence concerning the quality of existing supplies in the area to some extent supports the view that a paternalistic attitude should be taken by public authorities regarding the provision of potable supplies, for not only are private supplies allowed to deteriorate, but some people, as we have noted, are unwilling to incur the small expense of connecting to a higher quality supply when it is immediately available. If individual householders are content to consume unsatisfactory supplies, there is a case for protecting them from themselves by the provision of supplies by public authorities.[1] Such authorities, employing qualified staff, are presumably in a better position to judge the danger to public health of existing supplies than the individuals concerned. This argument is reinforced by the fact that a waterborne disease may be communicated by the actual consumer to other individuals as well.

3.2.18 It is interesting to note that responsible opinion generally accepts the view that while local residents build up some immunity against certain of the organisms polluting their supplies, visitors to the area may suffer unpleasant and possibly dangerous conditions through drinking this water. Increasing mobility of the population, the growing demand for homes for commuters to Shrewsbury (and possibly in the future to Telford), as well as a tendency in

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[1] The implication is therefore that other devices, such as free provision of water-purifying tablets or campaigns to publicise the need to boil drinking water, would be ruled out on this account.

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some parts of the area for properties to be bought by people from outside the district for retirement or weekend homes, may therefore increase the public health risk.

3.2.19 The vagueness surrounding the potential danger to public health of private supplies is unsatisfactory, particularly as public health considerations appear to be the main reason for pressing on with costly water supply projects in ever more remote areas. Ideally, we should be able to estimate the potential net social loss (in monetary and non-monetary terms) due to the consumption of inferior water supplies. These costs, which would be avoided, could then be shown as a measure of the benefits of a water supply project, to be weighed, along with other quantifiable benefits, against the costs of the project itself.

3.2.20 It is not the job of the economist, *qua* economist, to judge whether or not a scheme should go ahead on the results of this calculation. Social reasons may dictate that a water supply project should be carried out even if the monetary costs of the scheme exceed its monetary benefits, but at least the policy maker should be presented with a clear choice in that the monetary cost of avoiding a given risk to public health should be made as explicit as possible. This would clearly be more satisfactory than regarding the public health risk as an absolute constraint.

3.2.21 It would seem that research into the risk of waterborne disease, and the consequent loss in net output that would be involved should inferior water supplies continue to be used, should be the responsibility of health authorities. Thus, if it is reasonable to expect public health authorities to be in a better position than individual consumers to judge the danger to health of these private supplies, is it not also reasonable to ask them to be more precise in their estimation of the risk entailed? The first conclusion of the present exercise, therefore, is that the fundamental assumption regarding the necessity of providing mains supplies to all consumers should be more rigorously investigated.

3.2.22 Because of the uncertainty concerning public health, we have had, in this exercise, to conform to official policy in accepting the constraint that households in the South Atcham area must be served, or given the opportunity to be served, with mains supplies. The 'do nothing' solution, therefore, is rejected.

3.2.23 This does not however mean that any scheme, however expensive it may be, should be allowed to proceed, for there remains a further possibility. If it is essential that households should be given the opportunity of receiving mains supplies, and yet there are grounds for believing that in some sense it is too costly to take water to the people, why not instead take people to the water? In other words, why not build houses nearer to the source of supply and in more concentrated groups, and encourage people now living in scattered locations to move into the new properties?

3.2.24 This would provide an alternative method of meeting the requirement that people should have the opportunity of receiving potable water supplies, and the cost of this method can be a benchmark by which the net social cost of the scheme originally planned can be evaluated. We would therefore employ the 'alternative cost' approach to the investment decision, which equates the gross

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benefits of project A with the costs that would be incurred if project B, the cheapest known alternative method of meeting an exogenously determined target, were to be carried out. (In fact, there must always be doubt whether B *is* the cheapest alternative: we shall show below[1] that we have no reason to believe that our alternative settlement pattern *is* the cheapest possible, for still further intangible constraints regarding relocation sites are introduced).

3.2.25 In general, where the bulk of the benefits likely to accrue from a public investment is incalculable in monetary terms, there is no escape from a 'requirements' or 'least cost' approach of this nature. In the case of a rural water supply project, however, as we have already noted, the target of providing all consumers with mains supplies might confer public health benefits that are quantifiable in monetary terms and which can be offset against the costs of a scheme. In fact, such an exercise, including the identification of non-monetary as well as monetary benefits in terms of public health, would enable the policy maker to judge whether or not even the cheapest scheme was too costly in relation to the benefits provided. Theoretically, it is clear, the alternative cost approach is very much a second best and a greatly inferior substitute for the measurement of the real benefits accruing from a scheme. On the other hand, it is possible that given full knowledge of the public health hazard emanating from existing supplies, the attainment of the proposed target at least cost would still be considered justified.

3.3. Commercial and Industrial Water Use

3.3.1 The benefits of a water supply project (and therefore, by implication, the cost of the 'do nothing' alternative) to industrial and commercial enterprise in the area can be quantified in terms of the value of the net increase in output resulting from it. The value to the enterprise concerned will provide at least a rough guide to the value to society as a whole. In this area the commercial organisations concerned are farms; closer investigation of the agricultural implications of the alternative schemes is reserved for the appropriate chapter below.[2]

3.4. Fire Fighting

3.4.1 The extension of mains supplies to an area may confer another benefit, in improving fire fighting efficiency. It was indicated that in this area, dairy regulations, which require that ponds and other open water on dairy farmers' land should be filled in, have meant a diminution in the general availability of water for fire fighting purposes. Even where there are open supplies these cannot be relied upon, for there is less water available when it is most needed, i.e. in times of drought.

3.4.2 The attitude of fire authorities to the extension of mains supplies is, in fact, very similar to that of the health authorities and, equally, there is uncertainty regarding the monetary benefits of mains for fire fighting purposes. A preliminary inquiry into the practice of fire insurance companies was made, the idea being

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[1] See Chapter 4.
[2] See Chapter 7.

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to ascertain whether the premiums payable for fire insurance on properties not within convenient reach of mains supplies were higher than for other properties. If this were so, an estimate of the additional sum individuals annually pay insurance companies for living in such properties could be taken as the annual social cost, on this account, of so doing. In fact, it appears that additional premiums are usually not charged, the implication therefore being that insurance companies are not seriously concerned with the additional fire hazard that may be involved.

3.4.3 We have not gone into this in more depth mainly because we have accepted the public health constraint that households must be given the opportunity to obtain mains supplies. Since the question at issue is merely to compare the social costs of taking water to individuals in alternative locations, it is apparent that roughly equal facilities for fire fighting, and a roughly equal monetary fire risk for these households will be found on both sides of the calculation. (There may in practice be monetary savings due to the greater accessibility of the new houses, but we have made no attempt to quantify this, assuming it to be a negligible amount.) The fire fighting aspect is therefore ignored, but it would merit closer analysis if the 'do nothing' solution were to be treated as a serious alternative. To this general principle the reservation should be added that later on we will be making the assumption that certain buildings would remain in commercial use in the areas abandoned for purposes of habitation. Ideally the potential savings in respect of these properties due to the water supply project should be included as an offset to the cost of the scheme, but in view of our admittedly superficial preliminary findings on the subject, we have taken this no further.

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4. The Choice of Relocation Sites

4.1. General Principles

4.1.1 The remainder of the exercise is a study of two alternative courses of action:—(a) continuation of the existing policy of providing a piped water supply to dwellings in the South Atcham area, and (b) rehousing the population in locations more convenient for the provision of mains services. The repercussions of the second possibility are clearly vast, and in the following pages we examine the effect on such diverse areas as sewerage, education, mobile libraries, electricity, telephones, housing, health and welfare services, mail, passenger transport, refuse collection, travelling shops, as well as the main commercial occupation in the area, agriculture.

4.1.2 The method used is to estimate the present worth of the social costs that would be incurred if individuals continue to live where they are now and receive piped water supplies and all the other services mentioned, and then to estimate the costs that would be incurred should these people be rehoused in certain specified locations. At this point it is important to note that the extreme case is considered in which *all* householders in a given district move: discussion of the overwhelmingly important social, financial and legal implications of this is left till the end of the study.

4.1.3 In deciding upon suitable areas for relocation, we have operated within our own constraint that the sites selected should be ones from which it would not be unreasonable to expect individuals to continue to work where they do at present. By this means we have tried to avoid an upheaval in the local employment structure of such a magnitude that we would be totally unable to trace the effects of the change. In any case, we did not want to suggest depopulating the whole area, but only to illustrate the effects of relocating individuals *within* that area. The selection of relocation sites must be to some extent subjective, and we would by no means declare that, even within our self-imposed constraints, they are in any way optimal, for to know the optimal alternative would require knowledge of the magnitudes this study is designed to provide. It would, however, be hoped that by identifying the important effects of relocation, the study would make for more efficient identification of relocation sites in any other study of this nature that might be carried out. In this study, therefore, we do no more than provide what is, *prima facie*, a sensible alternative to the originally planned water supply scheme, and use this as a basis for comparison of the costs that provision of mains supplies would involve.

4.1.4 There is a distinct possibility that our calculations would show the costs entailed by the maintenance of the existing settlement pattern for the whole area to be greater (or smaller) than the net costs of relocation, whereas a different result would be obtained if we made similar kinds of estimates for certain individual parts of the area. For example, the less densely populated districts may show a net saving if depopulated, whereas the overall result for the area may not. We therefore divided the study area into sectors and, in the light of our

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relocation plans, carried out a separate calculation for each one, and for all possible combinations of them. An optimal solution, avoiding all cross-subsidisation, would in fact require a separate calculation for each property in the area, but in practice the difficulty in collecting data meant that we have had to settle for something less ambitious, this being a division of the study area into four sub-areas.

4.2. The Four Sub-Areas

4.2.1 Inspection of Map 2 shows that the study area falls conveniently into four major sub-areas for water supply purposes, and we used these as our basic units, designating them A, B, C and D. Within each of these areas, as we have noted, a water main is in joint supply, since its services are at once potentially available to all consumers: they could connect to it if they wished, and water would flow to their homes by gravity.[1] This is not so *between* areas, however, for they are separated topographically: in the case of Areas A, B and C, although all the water comes from a common source, the construction of a main in A does not also provide water for the inhabitants of B and C: water has to be boosted from Area A before it is made available to these consumers. And although, if water were available to B and C, it could flow by gravity to consumers in A, this is not of such practical relevance since the main has to pass through A before water can be pumped to B and C. Finally, as we have seen, Area D is served by a completely different source.

4.2.2 Given four sub-areas, the general task is to compare the net cost of:—

(a) maintaining the existing settlement pattern, i.e. no relocation, with

(b) the various alternatives open to us in terms of the combinations of sub-areas that might be abandoned, and the population relocated. These are:—

A	B + D
B	C + D
C	A + B + C
D	A + B + D
A + B	A + C + D
A + C	B + C + D
A + D	A + B + C + D
B + C	

4.2.3 With four sub-areas there are therefore fifteen possible alternatives to the existing situation. To take as an example the first possibility on the above list, we would estimate the costs that would be incurred if people in Area A were rehoused, the remainder of the study area (B, C and D) remaining unchanged. The last possibility listed is the extreme case, in which the cost of rehousing everyone in the study area is estimated.

4.2.4 The difficulty of data collection is the main reason for restricting the analysis to only four sub-areas; even with this number we might, in general,

[1] The second boosted area in B is an exception to this rule. This could have been included as a fifth group, but in view of the difficulty of collecting data, this was not done.

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expect to have to carry out the fifteen sets of calculations for each service considered. In other words the solution for A + B + C + D does not merely consist of summing the results of A, B, C and D. Such a solution would be incorrect if there are services that are common to any two of the specified areas, or if there are economies or diseconomies of scale in providing services for the relocation sites. This point will be illustrated as we proceed. Before specifying the appropriate areas for relocation, however, we must briefly examine the nature of our sub-areas.

Area A (20·9 *square miles*)

4.2.5 This is the northern part of the study area, consisting of the eastern part of the parish of Condover and the parishes of Acton Burnell, Frodesley, Longnor and Leebotwood, and which corresponds roughly to physical area (i) described in paragraph 2.1.5. This consists of agricultural lowland, already considerably affected by commuter development and developing the familiar characteristics of rural areas found on the fringes of conurbations and large towns. These characteristics, a growing population density, considerable post-war building, an increasing professional and commercial element in the occupational structure, and a younger population,[1] are at present most clearly developed in Condover.

4.2.6 There are estimated to be 793 properties of various kinds in this area, of which 383 are already adequately served by the W.S.W.B.[2] In general, the area is more densely populated than the rest of the study area, and for our present purposes this is one of the most important characteristics to be identified. Overall, the 'household density' is roughly 34·9 per square mile, compared with about 24·8 for the study area as a whole. For individual parishes the density is roughly as follows[3]:—

TABLE 4.1

Parish	Households per square mile
Condover (part)	52·1
Acton Burnell	20·5
Longnor	27·0
Leebotwood	30·3
Frodesley	11·6
Mean density	34·9

Area B (11·7 *square miles*)

4.2.7 Area B, the southern portion of the study area, consists of the bulk of Cardington parish and approximately two-thirds of each of Church Preen and

[1] In 1961 12·6% of the population of Condover were of retiring age, compared with 14·9% in the remainder of the study area. In 1966, the proportion for the rest of the study area was 15·9%, while for Condover it was 11·7%.

[2] This is dealt with more fully in Chapter 6.

[3] The household density of the *whole* of each parish is estimated even where the parish is split up among our sub-areas. On the other hand, we only estimate the density of those parts of the parishes that lie within the study area as a whole. (This applies to Condover and All Stretton only).

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Ruckley and Langley. Here is to be found a more scattered settlement pattern, this being an area with a far higher agricultural element in the employment structure than in Area A. These parishes form part of physical sub-area (ii), and communications within the area are generally poor. There are 163 properties in the area, of which 35 receive satisfactory W.S.W.B. supplies. Household densities:—

TABLE 4.2

Parish	Households per square mile
Cardington	15·3
Church Preen	17·5
Ruckley and Langley ...	7·9
Mean density	15·0

Area C (3·1 *square miles*)

4.2.8 This consists of the parishes of Woolstaston and of the western part of All Stretton. Area C lies to the east of the rest of the study area and, with Area B, forms part of the physical sub-area (ii). It is similar to B in most respects. There are 59 potential connections, but no W.S.W.B. supplies exist at present. Household densities:—

TABLE 4.3

Parish	Households per square mile
All Stretton (part)	23·7
Woolstaston	20·6
Mean density	22·4

Area D (6·1 *square miles*)

4.2.9 The parishes of Hughley, Kenley and the remaining parts of Cardington, Church Preen and Ruckley and Langley form the eastern sector of the study area. This is basically a lowland agricultural area, with scattered villages and hamlets, and corresponds approximately to physical sub-area (iii). Communications with neighbouring urban areas are poor and it is considered that there is little potential for non-agricultural development in this part. As yet, the W.S.W.B. has not penetrated Area D, and there are 85 potential connections should it do so. Household densities:—

TABLE 4.4

Parish	Households per square mile
Hughley	8·7
Kenley	12·4
Mean density	10·3

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4.3. Relocation Sites

4.3.1 Density of population and the general nature of the settlement pattern in the four sub-areas are fundamental in determining those areas which could be abandoned and those which could be used as relocation sites. *Prima facie*, should the existing settlement pattern be retained, the major element of cost, subject to the public health constraint, will be the actual cost of providing the piped water supply. On the other hand, should relocation proceed, the major social cost will be the foregone utility (approximated by market value) that would have been derived from the occupation of existing properties. In deciding upon relocation sites we were governed mainly be these considerations; the cost of water supply on the one hand and the value of existing properties on the other.

4.3.2 In view of the fact that the abandonment of properties involves a social cost, existing concentrations of population in the area were examined in order to see which ones might act as development points, or at least, which should not be abandoned. For this purpose the following villages can be identified, it being apparent from the outset that Area A is in a different category than the other three:—

Area A	*Area B*	*Area D*
Condover	Cardington	Hughley
Dorrington		
Acton Burnell	*Area C*	
Longnor	Woolstaston	
Leebotwood		

Area A

4.3.3 Depopulation of Condover and Dorrington was rejected at once. These are the two largest villages in the study area with, *prima facie*, the highest existing stock of capital in terms of private housing. Moreover, both are conveniently situated for Shrewsbury, being to the north of the study area, and close to the A49, the only classified road in the study area. Even more importantly for our present purpose, they are already served with mains, although current water supplies are intended to be replaced by the nearby Condover source. However, a link main to serve potential consumers in the area between these two villages is part of the projected scheme.

4.3.4 As far as communications are concerned, Longnor and Leebotwood, situated on or close to the A49, appear to be suitable development sites. In addition, being fairly central for the study area, they have the advantage over Condover and Dorrington in that they would also provide convenient alternative locations for those presently living in B and C. (It will be recalled that we wished to restrict the distance individuals would have to move to a minimum.) For these reasons Leebotwood and Longnor were selected as the first development points. This was a crucial decision, for several important repercussions followed.

4.3.5 First of all, it was confirmed by the Water Engineer that should these two villages, in company with Condover and Dorrington, receive water from the Condover borehole, it would remain necessary, as in the original comprehensive

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scheme for A, to pump water from Condover to the reservoir at Frodesley, from which the water would flow in a westerly direction to these villages. The fact that the main back to Condover would pass, as before, through Frodesley, and the proximity to the main of Acton Burnell, also indicated that these villages should not be scheduled for abandonment. Noting the proximity of Acton Burnell to the eastern sub-area D, we selected this village as being a suitable relocation site for inhabitants of D.

4.3.6 Indeed, any dwelling in Area A remaining close to the restricted mains system, should these villages be retained or developed, should not be abandoned. This caused some difficulty, for how should 'close' to the mains be defined? Should it be 100 yards—or one mile? For this purpose it was necessary to estimate the cost of connecting each property in Area A to the restricted mains system, and if this was above a certain figure for any property the inhabitants of that property should be deemed to require rehousing in one of the development areas. The figure we intended to use, should it be necessary, was in fact the estimated market value of the property concerned.

4.3.7 As a theoretical point, we can scarcely avoid begging the question on this, simply because the 'certain figure' should ideally be of the type that the whole exercise is trying to establish, i.e. the net social cost of retaining a dwelling in its present use as opposed to the net social cost of rehousing its inhabitants elsewhere, and not *merely* the foregone value to an individual householder of that dwelling. We used this rule of thumb guide, however, because it was believed that this would be the most important element of the rehousing cost.

4.3.8 Fortunately, in this particular case, it was fairly clear, having accepted the restricted mains system in Area A, and upon inspection of the distances between individual properties and the system, that there was always a wide divergence between the connection cost and market value of properties concerned. Although in some cases properties were about a mile from the mains, which at an average cost of about £1 per yard for such connections would mean a total of some £1,760, it was always true in such cases that some of the connection cost could be spread over a number of properties. Thus in no instance did we seriously have to compare the cost of connection with estimated property values, even under the restricted mains system aimed only at serving Condover, Dorrington, Leebotwood, Longnor and Acton Burnell villages.

4.3.9 The conclusion, therefore, was that if these villages are retained, all properties in Area A should also be retained. Having accepted this, however, it would presumably be more efficient to achieve the object of supplying all consumers in the area by using the original comprehensive mains plan suggested by the Water Board than to rely on a host of individual connections. Consequently, the planned scheme for Area A should be left untouched. If so, it is estimated that with roughly 400 potential connections (assuming that all households connect), the mean connection cost per property is only about £50.[1]

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[1] See Tables 6.4 and 6.6. The necessity of assuming that all consumers connect to the mains is discussed in paragraph 6.3.7.

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Areas B, C and D

4.3.10 Areas B, C and D are different in kind from Area A, being much more 'rural' and therefore more relevant for the ultimate aims of this study. In particular, it is not possible to identify any obvious focal points or villages that have particularly strong claims to be development sites.

4.3.11 The largest village to be found outside Area A is Cardington, which consists of about 45 houses, of which about 35 are already served by the W.S.W.B. Although the Water Engineer considers this supply to be unsatisfactory, and extension of supply from the source to other consumers is not possible, the public health risk is, at the existing rate of consumption, minimal. Consequently, relocation would not be necessary for these 35 households. The loss in social capital should those homes in Cardington that are not supplied by the W.S.W.B. be abandoned would therefore be restricted to the remaining ten or so properties.[1] Moreover, Cardington is by no means a central focal point for the study area, or even for Area B, being located on its southern boundary. Communications, too, are poor, which would make concentration of population in the village a particularly costly exercise because of the road improvements that would be necessary. Very similar considerations apply to Woolstaston (C) and Hughley (D). The villages in question are all at the remote edge of their areas for water supply purposes, and general scope for development is limited. This is recognised by the county planning authorities who, moreover, had no strong objections to the selection of Leebotwood, Longnor and Acton Burnell as potential development sites on grounds of cost or economic efficiency. There are other objections, however: these form part of a much wider question and are discussed later on.[2]

4.4. The Numbers Involved

4.4.1 We have already indicated the total number of properties of various kinds in each of Areas A, B, C and D. The rehousing alternative demands that for B, C and D we isolate those properties of a *residential* nature that currently use unsatisfactory supplies. Residential properties are defined to include farms, inns, shops and any other commercial premises that are used partly for residential purposes. (The sort of buildings excluded in a rural area such as this include parish halls, churches, schools, etc.) On this basis, the number of residential properties in each area is as follows:—

B—128 C—56 D—81

4.4.2 The number of residential properties in B, C and D not receiving adequate supplies is therefore 265. If rehousing took place, Leebotwood would be a convenient alternative location for all of Area C (56 dwellings), while Acton Burnell would be a reasonable relocation site for Area D (81 dwellings). It was decided that the best solution for B would be to divide it into three parts, so that the western part (50 dwellings), the central part (38) and the eastern part (40) could be allocated to Leebotwood, Longnor and Acton Burnell respectively.

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[1] This is subject to certain reservations, discussed in Appendix I.
[2] Paragraph 17.4.2.

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These numbers are based upon the criterion that people should be moved as short a distance as is reasonably possible from their existing locations.

4.4.3 Our finding that Area A should be left unchanged means that we now have only seven calculations to make on the possible effects of rehousing. We have to compare the social costs incurred if inhabitants of A + B + C + D continue to live where they are now, with the following seven possible situations, in which inhabitants of B, C and D are relocated in the specified parts of A. In every case, inhabitants of A are presumed to continue living in their existing homes:—

TABLE 4. 5

Inhabitants of	Relocated In	No. of Dwellings
B	Leebotwood ...	50
	Longnor	38
	Acton Burnell ...	40
C	Leebotwood ...	56
D	Acton Burnell ...	81
B + C	Leebotwood ...	106
	Longnor	38
	Acton Burnell ...	40
B + D	Leebotwood ...	50
	Longnor	38
	Acton Burnell ...	121
C + D	Leebotwood ...	56
	Acton Burnell ...	81
B + C + D	Leebotwood ...	106
	Longnor	38
	Acton Burnell ...	121

4.4.4 Finally, calculations in this study were made on the assumption that *all* households in the areas (B, C or D) being considered are relocated. It will be made quite clear in the following pages that a compromise solution, in which the bulk of the planned water supply scheme for a given sub-area went ahead, yet a proportion of houses within the sub-areas defined above were abandoned, would in fact yield (in cost terms) the worst of both worlds.

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5. The Alternative Cost Calculation: General Principles

5.1. Presentation of Results

5.1.1 In the following chapters the repercussions that would follow should the rehousing solution proceed are quantified in monetary terms. In most cases it has been found more convenient to estimate the present worth of the costs should the existing settlement pattern be retained and to deal with the rehousing costs as an entirely separate calculation, in which case our findings are presented in the following form:—

$$\sum_{t=o}^{30} \frac{C_t^E}{(1+r)^t} \quad \text{and}$$

$$\sum_{t=o}^{30} \frac{C_t^R}{(1+r)^t}$$

where C^E = costs of existing settlement pattern,
C^R = costs of rehousing resolution,
r = the appropriate annual rate of discount,
t = a one-year time period.
30 years is an arbitrary cut-off point for the calculations.

In other cases we present our findings in the following form:—

$$\sum_{t=o}^{30} \frac{C_t^E - C_t^R}{(1+r)^t}$$

which provides an estimate of the *net* benefit (or cost) of relocation for a given sector of our inquiry.

5.1.2 If all the estimates were accurate, use of these two methods would clearly yield the same result in terms of the net social cost of relocation. For expositional purposes, the first one is better, since it provides a clearer picture of the repercussions involved and shows the *total* cost of providing given service, but where there are variable costs which are 'joint' to both the existing situation and to the rehousing situation, some spadework can be avoided by ignoring the joint cost element. As an example of this, let us suppose that we wanted to estimate the effect of rehousing on the costs of a vehicle delivering groceries, which has to make a journey from 10 miles outside the study area. This 10 miles will involve a cost that is joint to both 'before and after' situations. This could be estimated, but as it would appear on both sides of the calculation, we ignore it. This explains why there is some lack of uniformity in the way the calculations are presented in the following pages.

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5.2. The Standard of Facilities

5.2.1 Where possible, the estimated costs of supplying the same standard of service as exists with the current settlement pattern are presented. This will be elaborated on in sections dealing with various aspects of the changed situation, but for the moment it should be said that it is no part of the present study to suggest the introduction of improved facilities for the individuals concerned. Clearly, to do so would add a new dimension to the study, for the improvement in the *standard* of a service to a community is a decision of an entirely different nature. It is also a more difficult one conceptually, because of the problems of directly quantifying benefits that are usually involved.

5.2.2 On the other hand, some change in the standard of facilities is unavoidable, and these are sometimes, but not always, reflected in the terms of the main part of the calculation, i.e. in monetary terms. Where this is not so, all we can do is to draw attention to the unquantifiable direct effects of the rehousing solution. In some cases the policy-makers concerned have indicated that, should relocation proceed, a change in the standard of service would probably follow, the implication usually being that the existing settlement pattern involves the provision of services that are inferior in character. The costs and benefits such a change in policy for these households would involve similarly do not form part of the calculation, though we also draw attention to these potential indirect effects.

5.3. Repercussions Outside the Study Area

5.3.1 In one respect conservative estimates are made of the savings accruing from relocation, for we have had to ignore possible repercussions outside the study area as a whole, as well as outside the particular sub-areas being considered at the time. For example, the concentration of the population of a rural area into one small group may mean a saving to a refuse collection team of an odd half-day per week. This is used as an estimate of the total time saved, but potential time savings may, in fact, be greater than this, for as a consequence of the change there could be a reshuffling of refuse collection routes throughout the remainder of the Atcham R.D.C. Difficulty of data collection in general precludes the estimation of such repercussions, but to the extent that they do exist, our estimates are of the *minimum* potential saving accruing from relocation, given that the standard of service remains the same. This assumes of course that the time saved in travelling would otherwise be put to productive use that is equal in value to the wage payable for that amount of time.

5.4. Market Prices and Social Costs

5.4.1 We are concerned throughout with the real cost to society of the alternative schemes. Thus, where possible, market prices are adjusted to allow for transfer items of various sorts by deducting the tax and adding the subsidy element involved. Where it is not possible to isolate such transfer items, market prices have to be used as a measure of social opportunity cost, although this is clearly not entirely satisfactory. Thus, in estimating the net cost of a water supply scheme, costs are defined to include subsidies paid by the central govern-

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ment and the appropriate county council, but we have been unable to subtract from the total cost the proportion that represents, for example, the tax paid on the fuel used by construction vehicles. This is a problem of general applicability to cost-benefit analyses.

5.4.2 It should also be noted that all costs over the period t_0–t_{30} are quoted at current prices, no allowance being made for an expected inflationary trend. Although possible changes in the *general* price level should be ignored since we are concerned only with costs and benefits in real terms, it would be theoretically desirable to adjust for expected changes in *relative* prices of inputs and outputs, although in the present study this has not been possible.

5.5. Future Housing Development in the Study Area

5.5.1 This study does not take account of the possibility of future housing development but deals solely with the *existing* number of properties in the study area. This can be explained as follows:—

Let C = the net cost of providing services, etc., if the existing settlement pattern is retained,

R = the net cost of providing services if existing properties are abandoned and the population rehoused,

n = the existing number of properties,

C′ = the additional cost of providing services for newly constructed properties if relocation does not take place (i.e. *inside* the study area),

R′ = the additional cost of providing services for newly constructed properties (*outside* the area) if relocation does not take place, and

n′ = the number of newly built houses.

5.5.2 It is assumed that development of the study area would only take place if the water supply scheme goes ahead. For the purpose of the present exercise, consistency would demand that in the absence of mains supplies construction of new properties in the study area would not be permitted. Should the water supply scheme proceed, therefore, we would expect the present worth of the average cost per property of supplying services in the study area to fall as the number of properties grows, i.e.:—

$$\frac{C + C'}{n + n'} < \frac{C}{n} \qquad (5.1)$$

5.5.3 However, as noted above, estimates of the cost of providing the various services dealt with in this inquiry do not allow for the possibility that at some future date more houses might be constructed in the study area. Ideally, to do so would require knowledge of when and where the new houses would be built in the area if the water supply scheme proceeded, and the alternative time and precise place of construction outside the area if the water supply scheme were rejected wholly or in part. Only then could the relative costs of the two situations

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be estimated. The necessary omission of such a calculation does not, fortunately, appear to be serious.

The implication of the omission is in fact that:—

$$C - R = (C + C') - (R + R') \tag{5.2}$$

or that

$$C' = R' \tag{5.3}$$

5.5.4 Expression (5.3) is not inconsistent with (5.1) and there are, in fact, no particular grounds for supposing the equality specified to be unreasonable, for if water mains are already laid and if other services continue to be provided for existing households, the *marginal* social cost imposed by new housing developments should be no higher within the study area than elsewhere. Thus the *absolute* difference between the costs applicable to the pre- and post-relocation situations should not be altered significantly by the possibility of new housing development within the study area.

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6. Water Supply

6.1. Introduction

6.1.1 In this chapter the cost of supplying water to all households, according to the various possible relocation alternatives, is examined. The general pattern to be followed in this and the succeeding chapters is that estimates are made of the annual costs incurred in providing the service under consideration over a period of 30 years (t_0, t_1 . . . t_{30}). Estimates are given of the costs incurred should no relocation at all take place, and those incurred should the inhabitants of B, C, D, (B + C), (B + D), (C + D) or (B + C + D) be relocated.

6.1.2 The annual costs of water supply can for convenience be divided into four elements, designated as (a) capital, (b) connection, (c) replacement, and (d) running costs. These are dealt with in turn.

6.2. Capital Costs

6.2.1 Water supply capital costs are as shown in Table 6.1. It has been assumed that the whole of this element of cost would be incurred in the first year. The sort of expenditure included under this heading will be the cost of sinking the new boreholes, installation of pumping equipment, boosters, service reservoirs and those water mains and pipes that are not paid for by individual consumers.

TABLE 6.1
Water Supply Capital Costs (£)

	Area Relocated							
Year	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0	669,236	503,743	629,848	592,122	464,355	426,629	552,734	387,241

6.2.2 From the above, it is observed that the savings in capital costs, should inhabitants of the various areas be relocated, are as follows:—

TABLE 6.2
Capital Cost Savings: Water Supply (£)

B	165,493	B + D ...	242,607
C	39,388	C + D ...	116,502
D	77,114	B + C + D	281,995
B + C ...	204,881		

6.2.3 The first thing to notice is that the saving should any combination of areas be relocated is merely the sum of the savings should individual parts be relocated. Moreover, the figure of £387,241, the capital costs entailed should B, C and D be relocated within Area A, is equal to that incurred should the Condover scheme apply solely to consumers presently living in A. The capital

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cost of supplying B, C and D is therefore, in this example, a simple addition to the cost of supplying A.

6.2.4 As far as B and C are concerned, this means that relocation would not involve an alteration in the size or location of mains and other works within A, and the houses of relocated families would simply be connected to the mains system already planned for A. The presumption, therefore, is that the most efficient system for serving A alone is also the most efficient one for serving A + B, A + C or A + B + C. Since the number of households will not alter, the flow of water for domestic use will be roughly the same with or without relocation: there would, however, probably be some change in agricultural consumption, but this is considered to be insufficient to warrant a change in the size of mains or service reservoir. Neither this fact nor the compression of the area of supply would require changes in pump sizes either, although, as we shall see, there are potential savings in pumping running costs. The relocation of Area D, similarly, is estimated to have no repercussions on the mains structure originally planned for Area A. This is despite the fact that relocation of D would, unlike B and C, mean an *addition* to the number of households to be supplied by the Condover source.

6.2.5 Clearly, the division of an area into four groups, and the estimation of capital costs for each combination of groups by simple addition, will not be a rule of general application. It would not be true, for example, of the combination of our areas A + B, and the individual parts A and B. The reason for this is that since the Condover source is located within A, the mains have to pass through A before those houses in B and C can receive mains supplies. Put another way, the mains system in A confers benefits not only on the inhabitants of A itself, but also to those of B and C, so that the cost of some of the assets in A are 'joint' to all three areas. Moreover, the simple addition method would not be appropriate if the removal of the constraint that B should also be served required, for the most efficient method of serving A alone, a re-adjustment of the mains system in A.

6.2.6 The above can be illustrated with reference to a point that may otherwise cause some confusion. Table 6.3 shows the savings *per household* in the areas concerned should relocation proceed:—

TABLE 6.3
Savings Per Household: Water Supply Capital Costs (£)

B	1,293	B + D ...	1,161
C	703	C + D ...	850
D	952	B + C + D	1,064
B + C ...	1,113		

6.2.7 Alternatively, this can be seen as a measure, subject to our constraints, of the cost per household should the areas remain populated. Now, if we look at Area A, which we have selected as the area which should *not* be depopulated, we find that the cost per household of assets located therein is of the order of

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£1,326,[1] a figure in excess of any of those quoted above, as well as for the area as a whole (£1,200).[2]

6.2.8 Because of the 'jointness' of some of the assets in Area A, this does not mean, however, that the relocation sites have been incorrectly selected; the fact that assets to the value of £1,326 per property happen to be physically located in A is not the crucial one, for it does not mean that depopulation of A would yield savings of this amount. To illustrate this, let us consider the two areas A and B only and define the cost of assets physically located in A as:—

$$A_1 + A_2 \quad [3]$$

where A_1 = cost of borehole, reservoirs, mains, etc., that are 'joint' to both A and B, and

A_2 = cost of assets that exist solely to serve consumers in A.

The total cost of water supply for Areas A and B together

$$= A_1 + A_2 + B_1$$

where B_1 = cost of all assets in Area B.

6.2.9 Now, if A were depopulated, the cost of supplying B, *if the 'joint' assets remained the same*, would be $A_1 + B_1$. The real cost of supplying A alone, and therefore the real saving if A alone were depopulated, would be A_2 rather than $(A_1 + A_2)$ and will therefore be something less than £387,241. In fact, assets located in A that are common to both A and B are as follows:—

Borehole, pumps and service reservoir	£77,260
12″ Pumping main	50,050
	£127,310

6.2.10 The saving if A alone were depopulated would therefore be £259,931, or £890 per property. On this basis, the cost per property of supplying consumers in Area A is less than the cost of supplying those in any other area or combination of areas, excluding C and (C + D). However, it is clear that the same principle can be applied to the jointness of assets between A and C as between A and B, so this point need not be laboured. Area D is distinct from the remainder of the study area in that there is no 'jointness' problem, but in any case the cost per property of Area D alone exceeds the figure of £890 quoted for Area A.

6.2.11 It is however conceivable that depopulation of A might allow opportunity for rationalisation of the mains system passing through A, so that the cost of the hitherto 'joint' assets or, indeed, of the assets in B, might be reduced. In these circumstances the real cost of supplying B would be:—

$$A_3 + B_2$$

---

[1] i.e. £387,241 for 292 properties (see paragraph 6.3.4—Table 6.6).
[2] i.e. £669,336 for 557 properties (paragraph 6.3.6, footnote [1] refers).
[3] $A_1 + A_2$ = £387,241.

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where A_3 = the cost of the revised mains system in A, no longer bound by the constraint that it should be convenient to supply consumers in A (or possibly the exploitation of an entirely new source of supply), and

B_2 = the cost of assets in B, also no longer bound by the constraint that A should be supplied.

The real cost of supplying A would therefore be:—

$$A_1 + A_2 + B_1 - A_3 - B_2$$
$$= A_4$$

But since, for a given standard of service,

$$A_3 + B_2 \leqslant A_1 + B_1$$
$$A_4 \geqslant A_2$$

6.2.12 Given the opportunity of rationalising the mains system should Area A be depopulated, the real cost of supplying A will thus be greater than or equal to the cost incurred if no such opportunity exists. It is this figure (A_4 or A_2) that we should use, rather than ($A_1 + A_2$), if the cost per household is to be estimated. However, A_4 and A_2 have not been precisely estimated for each relocation alternative, even though the selection of A for further development is partly determined by the assumption that, calculated on the basis outlined above, the real cost per household in Area A will be below that of the remaining areas. Area D can again be ignored in this context, but as far as Areas B and C are concerned, the absence of feasible alternatives to the Condover source, and the consequent importance of common assets suggests, *prima facie*, that this assumption is not an unreasonable one. (See Map 2.)

6.2.13 We turn now to the depopulation of Area B. We have seen that in the case of the South Atcham scheme the costs of $A + B = A_1 + A_2 + B_1$, and that the cost-saving if B were depopulated is simply B_1. (The cost-savings should C and D be depopulated are estimated in a similar manner.)

6.2.14 But suppose depopulation of B allowed a readjustment in the system of assets in Area A, the cost of which we shall define as A_5. The real cost of serving B would then be:—

$$A_1 + A_2 + B_1 - A_5$$
$$= B_3$$

Since it is assumed that $A_5 \leqslant (A_1 + A_2)$,

$$B_3 \geqslant B_1$$

6.2.15 Thus, supposing the mains system in A could be made less costly if Area B were to be depopulated, the real cost of supplying B would be greater than if such an adjustment were not possible. In this case, estimation of the effect of relocation would require alternative sets of calculations, based upon the different mains structures needed within Area A for each relocation possibility. In the particular example of South Atcham, this was not considered by the W.S.W.B. to be relevant, although it clearly could be important under certain water engineering conditions.

6.2.16 In this general context, it should be noted that the South Atcham study area as a whole is bordered by districts already served with mains supplies.

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The scheme is therefore of no potential benefit to premises lying outside its perimeter, and there is thus no element of 'jointness' of costs between the study area as a whole and outside areas. If there were, it would mean that our selection of the study area was incorrect. In fact, the original scheme presented for study was the planned supply for A and C only, B and D being added when it became apparent that inhabitants of these areas were potential beneficiaries. (It was subsequently decided that the best source for D was Uckington).

6.2.17 Finally, it will be observed that even when all three areas are relocated within A the capital costs of water supply are relatively high: at £387,241 for the B + C + D relocation situation they are some 58% of the costs that would be incurred if no relocation at all took place. Clearly, the potential savings on this account would be much greater in circumstances in which households could conveniently be relocated in areas already in receipt of mains supplies, and where the existing mains and other installations could accommodate the increased consumption without the need for further construction. This would not, however, be possible for the South Atcham situation without depopulation of the whole area A + B + C + D, in which case the requirement that it should be reasonable to expect people to continue to work where they do at present would not be met.

6.3. Connection Costs

6.3.1 Broadly speaking, connection costs can be distinguished from other capital costs in that the former are paid for directly by the consumer, while the latter are paid for by the water undertaking. The calculations below are based upon the assumption that everyone in the area does, in fact, connect to the main. For this purpose, every property was identified on a six-inch map, and the cost of connecting each one to the mains system was estimated, using the scale of charges for connection issued by the W.S.W.B.

6.3.2 Upon relocation, the plan is that households are to be placed in fairly homogeneous groups, and the connection cost per property for the new situation has been estimated as the average cost of connection on housing estates; this works out at approximately £33 per house. The effect of concentrating properties into such groups, conveniently placed for mains supplies, will reduce connection costs. The cost of connecting every property in the area should the existing settlement pattern be retained, and the costs and savings achieved by relocation are shown in Table 6.4.

TABLE 6.4
Water Supply Connection Costs and Savings (£)

	Existing Cost	Relocation Cost	Saving
A	20,000	20,000	n.a.
B	16,000	5,000	11,000
C	4,000	2,000	2,000
D	6,000	3,000	3,000
	46,000	30,000	16,000

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6.3.3 Since it has already been shown that the cost of the mains system for any combination of areas consists of the straightforward addition of the component area costs, it follows that we can do the same thing for the connection of individual properties to these mains. Consequently, connection costs for the various alternatives are as shown in Table 6.5.

TABLE 6.5
Water Supply Connection Costs (£)

	Area Relocated							
Year	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0	46,000	35,000	44,000	43,000	33,000	32,000	41,000	30,000

6.3.4 The most important issue concerns the fact that our estimation is made on the basis that all households will connect. In fact, it is fairly certain that if the planned water supply scheme went ahead many householders in the area would not connect at all, while for others, a considerable time would elapse before such action is taken. To illustrate this let us look at Area A, which is already partly served with mains, these having been installed in the year 1963.

TABLE 6.6
Possible Connections in Area A

	Domestic Properties	Other
Properties already served by W.S.W.B.	356	27
Properties which lie outside the existing mains system ...	292	15
Properties which could be served by existing mains but are not	93	10
Total number of properties in Area A	741	52

6.3.5 'Domestic' properties in Table 6·6 include households and any commercial or other enterprise which is partly residential (mainly farms, but also inns, shops, etc.). 'Other' connections refer to garages, schools, churches, etc., as well as the twenty or so commercial organisations located on the old Condover airfield.

6.3.6 The important thing to note here is the distinction made between those properties which lie outside the existing mains system and those which, although not actually served by the W.S.W.B., do not. Our distinction is based upon the distance from the relevant main: thus, a property is deemed to be outside the existing mains system if it is further from it than from any part of the new system. On this basis we ascertained that about 93 out of 356—i.e. over one-quarter—of domestic properties have not connected to the mains system designed for their use. When seen as an extension of mains supplies into areas hitherto unserved, the Condover scheme is therefore relevant for only 292

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properties in Area A.[1] A larger number than this will actually consume the Condover water, but for most of the properties it will merely be a case of substituting the source.[2]

6.3.7 In the face of such evidence, the assumption that all properties in the area connect to the mains requires some explanation. In fact, no prediction is made that people *will* connect: all we are doing is to demonstrate how much it would cost *if* they did. Since the 'alternative cost' approach to the problem is based upon the absolute constraint that the public health risk must be avoided—and that the provision of piped supplies is the way to do it—we are logically bound to estimate the cost of connecting all households to the mains. For what becomes of the public health argument for the extension of piped supplies if one-quarter of the population does not take advantage of them? The conclusion must be, therefore, that even though it may sometimes be unreasonable to expect an individual householder to meet the cost of connection himself, if society as a whole wishes to avoid the health risk to that consumer (and to those with whom he comes into contact), it must be shown how much it would cost society—irrespective of which organisation actually foots the bill—to do so. This approach is further justified by the fact that costs can only be compared on the basis of comparable facilities, and all properties in the relocation villages would of course receive mains supplies.

6.4. Replacement Costs

6.4.1 These consist of expenditure on the replacement of pumping equipment, which has an expected economic life of fifteen years. (This corresponds to the official amortisation period for such equipment.) Replacement costs are as follows:—

TABLE 6.7
Replacement Costs: Water Supply (£)

	Area Relocated							
Year	None	B	C	D	B + C	B + D	C + D	B + C + D
t_{15}	8,900	8,000	8,600	8,200	7,700	7,300	7,900	7,000
t_{30}	8,900	8,000	8,600	8,200	7,700	7,300	7,900	7,000

6.5. Running Costs

6.5.1 Table 6.8 gives the annual total costs of supplying water for the years t_0–t_{30}. After allowing for the capital, connection and replacement costs already described, the remainder of the entries in Table 6.8 consists of running costs. These are comprised, apart from an insignificant expenditure on chlorine,

[1] i.e. 557 in all.
[2] The properties in Acton Burnell served by the W.S.W.B. are included in the 356, but properties in close proximity to these mains are not included in the 93 because, as we have noted, there are physical reasons why they cannot at present use the Acton Burnell mains.

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entirely of pumping costs at the Condover and Uckington borehole, and at the various boosters.

6.5.2 It will be observed that running costs, and therefore savings due to relocation, are assumed to grow over time. This is based upon an assumed average rate of growth in consumption of 3·8% per annum, which corresponds to the W.S.W.B's forecast for the area should the existing settlement pattern be retained.

6.5.3 At this stage it is necessary to draw attention to the fact that relocation would have important repercussions on the farming community and that there would be a considerable reduction in the quantity of water used for agricultural purposes. This would mean that upon relocation the annual running costs of the W.S.W.B. would be reduced and, moreover, that the average growth rate would not be 3·8% but some different rate, based solely upon *domestic* water use.

6.5.4 This has not been allowed for in Table 6.8 for the reason that, under a separate heading, estimates are presented of the effect relocation would have on the net value of farm output.[1] Theoretically, since farm water supplies are metered, the reduction in running costs of the W.S.W.B. will be counted as a reduction in the cost of inputs to farms, and therefore to allow for this in our water supply account would involve double counting. A parallel argument refers to the use of the aggregate rate of growth in consumption, rather than the purely domestic rate.

TABLE 6.8

Annual Costs of Water Supply: Summary Table (£)

	Area Relocated							
Year	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0	721,686	544,185	679,948	640,700	502,447	463,199	598,962	421,461
t_1	6,743	5,689	6,381	5,856	5,327	4,802	5,494	4,440
t_2	7,038	5,939	6,665	6,114	5,566	5,015	5,741	4,642
t_3	7,334	6,189	6,949	6,372	5,804	5,227	5,987	4,842
t_4	7,629	6,439	7,233	6,630	6,043	5,440	6,234	5,044
t_5	7,925	6,689	7,517	6,888	6,281	5,652	6,480	5,244
t_6	8,136	6,869	7,719	7,072	6,452	5,805	6,655	5,388
t_7	8,347	7,048	7,921	7,255	6,622	5,956	6,829	5,530
t_8	8,559	7,228	8,123	7,439	6,792	6,108	7,003	5,672
t_9	8,770	7,407	8,325	7,623	6,962	6,260	7,178	5,815
t_{10}	8,981	7,587	8,527	7,807	7,133	6,413	7,353	5,959
t_{11}	9,192	7,766	8,729	7,990	7,303	6,564	7,527	6,101
t_{12}	9,404	7,946	8,931	8,174	7,473	6,716	7,701	6,243
t_{13}	9,615	8,125	9,133	8,358	7,643	6,868	7,876	6,386
t_{14}	9,826	8,305	9,335	8,542	7,814	7,021	8,051	6,530
t_{15}	18,937	16,484	18,137	16,925	15,684	14,472	16,125	13,672
t_{16}	10,201	8,624	9,693	8,867	8,116	7,290	8,359	6,782
t_{17}	10,364	8,763	9,848	9,008	8,247	7,407	8,492	6,891
t_{18}	10,528	8,903	10,004	9,150	8,379	7,525	8,626	7,001
t_{19}	10,691	9,042	10,159	9,291	8,510	7,642	8,759	7,110
t_{20}	10,855	9,182	10,315	9,433	8,642	7,760	8,893	7,220
t_{21}	11,018	9,321	10,470	9,574	8,773	7,877	9,026	7,329
t_{22}	11,182	9,461	10,626	9,716	8,905	7,995	9,160	7,439

[1] See Chapter 7.

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TABLE 6.8—*continued*

Year	None	B	C	D	B + C	B + D	C + D	B + C + D
t_{23}	11,345	9,600	10,781	9,857	9,036	8,112	9,293	7,548
t_{24}	11,509	9,740	10,937	9,999	9,168	8,230	9,427	7,658
t_{25}	11,672	9,879	11,092	10,140	9,299	8,347	9,560	7,767
t_{26}	11,836	10,019	11,248	10,282	9,431	8,465	9,694	7,877
t_{27}	11,999	10,158	11,403	10,423	9,562	8,582	9,827	7,986
t_{28}	12,163	10,298	11,559	10,565	9,694	8,700	9,961	8,096
t_{29}	12,326	10,437	11,714	10,706	9,825	8,817	10,094	8,205
t_{30}	21,390	18,577	20,470	19,048	17,657	16,235	18,128	15,315

Present Worth Equivalent

Discount Rate	None	B	C	D	B + C	B + D	C + D	B + C + D
6%	852,383	654,910	804,103	754,553	606,630	557,080	706,273	508,800
8%	825,360	631,976	778,408	730,988	585,024	537,604	684,036	490,652
10%	806,104	615,641	760,102	714,199	569,639	523,736	668,197	477,734
12%	792,025	603,700	746,719	701,926	558,404	513,601	656,630	468,305

6.5.5 Projections of water consumption are notoriously unsatisfactory on both conceptual and practical grounds, but the use of the trend does draw attention to the fact that if there is a growth in consumption over time the potential savings in running costs resulting from relocation will also increase. In fact, the growth in consumption, for the purposes of the present exercise, would be determined almost entirely by the increase in *per capita* domestic consumption, which is apparently correlated fairly closely with *per capita* personal disposable income.[1] Even in aggregate, however, the savings in running costs are relatively small, as the estimate for t_0 bears out.

TABLE 6.9

Water Supply: Savings in Running Costs (t_0 only) (£)

Area Relocated						
B	C	D	B + C	B + D	C + D	B + C + D
1,008	350	872	1,358	1,880	1,222	2,230

[1] Using annual data for the U.K. as a whole for the period 1954/5 to 1964/5, the following regression equation was obtained:—

$$C_t = 5{\cdot}492 + 0{\cdot}08\ Y_{t-1}$$

where C = *per capita* domestic consumption of water supplied by statutory water undertakings, (g.p.c.d.), and

Y = *per capita* personal disposable income (£ at 1958 prices).

$\bar{R}^2 = 0{\cdot}91$

Von Neumann Ratio = 1·33

Income coefficient significant at 1% level.

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7. Agriculture

7.1. Introduction

7.1.1 Agriculture would he considerahly affected by relocation, and in this chapter the nature of the changes that would he likely to take place are examined, with particular reference to the effect on the net value of agricultural output produced in the study area. This sector of economic activity, the only one of significance in Areas B, C and D, would clearly he of fundamental importance in any study concerned with the alternatives of supplying water in rural areas, or depopulation, and the methods employed in the following calculations should therefore he of general relevance. Considerable assistance and advice, hased upon knowledge of the actual farms in the study area, was provided locally hy officers of the National Agricultural Advisory Service of the Ministry of Agriculture, Fisheries and Food.

7.1.2 The first point to make is that to be consistent, the criteria applying to the non-farming community regarding the need for the provision of mains water supplies to protect health, must also apply to owners or occupiers of farms. Failure to obtain mains supplies would mean ahandonment (for residential purposes) of farm huildings, although the premises themselves may be retained for commercial purposes. However, residential ahandonment of farm huildings does not merely involve the construction of new homes to accommodate the displaced families, for problems of farm management would be created and, in particular, certain types of production could no longer he carried on. This would apply under any circumstances, but the tendency to switch from one form of production to another would be reinforced and, as we shall see, in the same general direction, if ahandonment were due to the health hazard arising from inferior water supplies.

7.1.3 The general objects of this chapter are first of all to estimate the social net value of agricultural output annually obtained if the water supply scheme goes ahead and the farms remain occupied, and secondly to provide similar data should farms be ahandoned and farmers rehoused in the relocation villages. The social net value of farm output is defined as the total revenue, excluding deficiency payments, received by farmers in exchange for their output, less the total cost of inputs, including the subsidy element.

7.1.4 The question of exchequer support of one kind or another involves prohlems that are peculiar to agriculture, and these require some explanation. Thus, in the ahsence of any subsidy element at all, the annual net income accruing to farmers, over and ahove a sum representing payment for their own labour, can be equated, roughly, to the net social henefit of agricultural output and can he defined as:—

$$N_t = R_t - V_t - F_t - Y_t,$$

where N_t = farmers' profits, or net social benefit,
R_t = gross revenue,
V_t = total variable costs,
F_t = total fixed costs,
Y_t = imputed payment for farmers' labour.

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7.1.5 Net income received by farmers is thus $N_t + Y_t$, of which Y_t represents payment for his labour, the remainder being defined as farmers' 'management and investment income'. The distinction between F_t and V_t is made because of the concept of the Gross Margin in agricultural economics. Most of the data and methods of estimation of the value of farm output make use of Gross Margins, and it is necessary to adapt our method of calculation to accommodate this. The Gross Margin (G_t) applying to any form of production is, in fact, defined as the income received by the farmer minus the variable costs incurred in respect of that type of output. Ignoring subsidies, therefore, $G_t = R_t - V_t$.

7.1.6 In the case of crop enterprises, variable costs are defined to include seed, fertilizers, casual labour, contract services and sprays, while for livestock they mainly comprise stock purchases, concentrates, feeding-stuffs and medicines. As such, variable costs correspond roughly to short run marginal costs when applied to any one type of product. Fixed costs are normally defined to cover all other expenditures made by the farmer, such as those on rent, machinery, buildings and regular labour. An imputed payment for the farmer's own labour does not fall within this category.

Returning now to the question of subsidies,

$$R_t = R'_t + R''_t,$$
$$V_t = V'_t + V''_t, \text{ and}$$
$$F_t = F'_t + F''_t$$

where R'_t = revenue from the sale of output,
R''_t = price deficiency payments,
V'_t, F'_t = variable and fixed costs met by the farmer, and
V''_t, F''_t = subsidy element of variable and fixed costs.

7.1.7 In this study we are concerned only with real (social) costs and benefits, in terms of the value of resources used up and goods produced. Real benefits are interpreted as the *market* value of the relevant output (R'_t) and real costs as unsubsidised costs ($V_t + F_t + Y_t$, or $V'_t + V''_t + F'_t + F''_t + Y_t$).

Thus,

$$N'_t = R'_t - V_t - F_t - Y_t, \text{ and}$$
$$N''_t = R_t - V'_t - F'_t - Y_t,$$

where N'_t and N''_t refer, respectively, to net social benefit and profits.

7.1.8 Clearly, the identification of R'_t, V_t and F_t, rather than R_t, V'_t and F'_t, with real benefits and costs is not altogether satisfactory and, to the extent that there are repercussions in real terms resulting from the subsidies in question, this will be incorrect. For example, if a farm subsidy helps to ease a balance of payments difficulty, and thereby avoids the need for a deflationary policy and a slowing down in the rate of growth of national income, this would certainly be a real effect, which ideally would be allowed for in a study of this sort. On the other hand, so small is the proportion of total agricultural output involved in the present study that this effect can be ignored. Partial equilibrium analysis is therefore assumed to be sufficient in this sector as, indeed, it has to be in the remainder of the exercise. Thus, although both subsidised and unsubsidised

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costs and values are set out in the following pages, and calculations on both bases are made, only estimates net of exchequer support are included in the final analysis.

7.2. Gross Margins, Exchequer Support, Fixed Costs and Farmers' Labour

7.2.1 Our aim is therefore to estimate the value of $R'_t - F_t - V_t - Y_t$ for each of the possible relocation solutions. In fact, we were able to obtain data for Gross Margins ($R'_t + R''_t - V'_t$), total exchequer support ($R''_t + V''_t + F''_t$), fixed costs met by the farmer (F'_t) and the imputed cost of farmers' labour (Y_t).

Since,

$$N'_t = (R'_t + R''_t - V'_t) - (R''_t + V''_t + F''_t) - F'_t - Y_t$$
$$= R'_t - V_t - F_t - Y_t,$$

net social benefit can be estimated directly from these data.

7.2.2 Estimates of Gross Margins and the extent of exchequer support for the various crops and types of livestock to be found in the study area are given in Table 7.1. It will be noted that Gross Margins are quoted on an annual basis, whereas they are often quoted, in respect of fattened calves and pigs, on a *per capita* basis. Thus, the *per capita* Gross Margins for categories (a), (b) and (c) of fattened calves are £18, £30 and £35 respectively: these are spread over the lifetime of the animals and brought to an annual-equivalent basis. For fattening pigs a threefold turnover per annum has been assumed, converting a 27/– *per capita* figure to £4 annually.

TABLE 7.1

Gross Margins and Exchequer Support for Agricultural Enterprises in the U.K.
(Average figures: 1963/4 – 1966/7)

Type of Enterprise	Annual Gross Margin ($R'_t + R''_t - V'_t$) (£)	Exchequer Support ($R''_t + V''_t + F''_t$) as a percentage of Gross Margin (%)
Livestock		
Dairy cows, per cow	84	5
Dairy replacements, per heifer reared ...	55	6
Beef cows, per cow	24	42[1]
Fattened calves		
(*a*) 14–18 months, per head...	13·5	87
(*b*) 21 months, per head	17	68
(*c*) 30 months, per head	14	65
Ewes and lambs, per head	7	50
Wintered lambs, per head	2	50
Pigs, breeding, per sow	19	10
Pigs, fattening, per fat pork pig	4	140
Poultry, laying, per hen	0·25	100
Arable		
Wheat, per acre	33	25
Barley, per acre	28	30
Oats, per acre	24	42
Potatoes, per acre	80	12
Sugar beet, per acre	60	6

[1] £10 calf subsidy.

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7.2.3 Exchequer support includes the value of price deficiency payments where appropriate, as well as the allocation of less specific grants and subsidies, some of which will be an offset to fixed, and others to variable, costs. In this general category would be included such things as ploughing grants and subsidies on fertilizers. All the estimates are based upon national data, those of the aggregate cost of exchequer support being published in the Annual Review White Paper.

7.2.4 The average cost of support for the financial years 1963/4 to 1966/7 is spread over the average production for those crop years. The average of the four years is used to reduce the distortions that would arise through annual fluctuations in support, particularly in the price deficiency payments in respect of pigmeat, fat cattle and eggs. Despite this, in view of the magnitude of annual and seasonal fluctuations, and of the difficulty in allocating subsidies that are of benefit to more than one form of output, the figures are at best only a rough guide to the extent of exchequer support, both over time and between different products. In addition, it will be appreciated that the quoted Gross Margins are themselves only a rough guide: there will certainly be variations between farms as well as between regions, and the limitations of using national data must be borne in mind.

7.2.5 Estimates of fixed costs for various farming systems were obtained from a survey carried out by the Universities of Bristol and Exeter.[1] Since fixed costs per acre are more stable than Gross Margins, the figures for one year only (1965/6) were used. From the Bristol and Exeter data, the fixed costs incurred in maintaining the existing farming system were estimated, as well as those involved in adjusting to the post-relocation situation.

7.2.6 Fixed costs per acre vary according to the size of holding, and to the proportion of acreage devoted to various types of output. Consequently, there is also variation in costs per acre between our Areas B, C and D. No fixed costs of general application are quoted here, therefore; since they depend upon the characteristics of individual farms and areas, they are dealt with separately in the individual calculations for B, C and D. It will be appreciated that the precision of these estimates when applied to the study area will be subject to reservations similar to those expressed concerning the accuracy of other figures of cost and revenue that have had to be employed in this section.

7.2.7 Payment for farmers' labour is also estimated separately for each area. The general method used is to estimate how much it would cost to hire farm managers to run each farm. For very small holdings, payment for farmers' labour is estimated at little more than the standard wage rate for agricultural labourers, while for larger farms salaries of £1,000 are envisaged. For non-viable farms, defined as those which yield a net income to the farmer that is less than the agricultural labourer's wage, often because the farm is only a part-time occupation for the owner, we have used an arbitrary figure of £400 per annum per farm.

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[1] *Farm Management Handbook*, 1967, Universities of Bristol and Exeter, 1967.

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7.3. The Cost-Benefit Calculation

7.3.1 In an area which was deficient in the quantity of water available for farm use, it is possible that the provision of mains supplies would result in an increase in the net annual value of farm output produced in the area. The present worth of the gross value of the increased output, less the present worth of the cost of the additional inputs required to produce it, would then be a benefit to be offset against the cost of the water supply scheme. However, given the availability of existing private water supplies and the type of farming land to be found in the region, it is considered that effects of this sort would be negligible. This applies equally to B, C and D, so we will have no further occasion to refer to this possibility. Consequently, in comparing the merits of the water supply scheme *vis à vis* relocation, the first task is to estimate the net annual value of agricultural output that would be produced *if things remain as they are*, the second being to make a similar estimate on the assumption that farmers are rehoused in the relocation villages.

Current Output—Area B

7.3.2 Area B contains 53 holdings, of which 39 are viable, and about 5,480 acres of farm land.[1] The present full-time agricultural labour force is about 84, consisting of the occupiers of the viable holdings plus 45 full-time employees.

7.3.3 Of the 5,480 acres, 500 consist of rough grazing land, one acre of which is taken in this area as being the equivalent, for purposes of supporting livestock, of 0·3 acres of other land. The 'adjusted acreage' is therefore 5,130, this being currently used in the following manner:—

TABLE 7.2
Land Use: Area B

Forage	
Turnips, Swedes, etc.	30 acres
Mangolds	2
Rape, Kale and Cabbage ...	49
Temporary Grass	1,347
Permanent Grass	2,308
Rough Grazing (adjusted) ...	150
Bare Fallow	48
Arable	1,196
Total Acreage	5,130

7.3.4 More specifically, the type of farming now being carried on in the area is indicated in Table 7.3, which also shows the returns accruing from various forms

[1] Some of the farm acreage considered as belonging to Area B may, in fact, be located outside that area: similarly, some agricultural land that is physically located within Area B may be excluded from the above total. This is because in considering relocation we are concerned solely with residential properties, and it is therefore the location of the appropriate farm house that determines whether or not land should be deemed to belong to a certain section of the study area. This explains the substantial discrepancies to be found between the total areas of B, C and D, quoted in Chapter 4, and the amount of agricultural land listed in the present chapter as belonging to each.

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of production in terms of Gross Margins. Adjustments are also made to allow for exchequer support.

TABLE 7.3
Area B: Current Farm Output
(*a*) Livestock

	Standard Acres Per Unit (1)	Present Number (2)	Acres (3)	Total Gross Margins (£) (4)	Exchequer Support (£) (5)	Gross Margins less Exchequer Support (£) (6)
Dairy Cattle						
Dairy Cows ...	1·9	659	1,252	55,356	2,768	52,588
Dairy replacements	2·0	172	344	9,460	568	8,892
Other Cattle						
Beef Cows ...	1·9	233	443	5,592	2,349	3,243
Heifers < 1 year	0·4	346	138			
Steers < 1 year ...	0·4	427	171	15,945 [1]	11,640 [2]	4,305
Heifers 1–2 years	0·8	137	110			
Steers 1–2 years	0·8	153	122			
Calves reared and sold during winter	0·1	200	20	1,200	—	1,200
Sheep						
Ewes and lambs	0·3	2,854	856	19,978	9,989	9,989
Wintered lambs	0·1	500	50	1,000	500	500
Pigs						
Breeding ...	—	133	—	2,527	253	2,274
Fattening ...	—	400 [3]	—	1,600	2,240	−640
Poultry						
Layers	—	6,810	—	1,702	1,702	—
		(*b*) Arable				
Wheat	—	—	194	6,402	1,600	4,802
Barley	—	—	912	25,536	7,661	17,875
Oats	—	—	90	2,160	907	1,253
		Total	4,702	148,458	42,177	106,281

[1] Since *per capita* Gross Margins depend upon the age at which the animal is sold, and we do not know what this will be, the total Gross Margin for heifers and steers is based on the average *per capita* Gross Margin, i.e. roughly £15 per head.

[2] Similarly, the exchequer support percentage is based upon the average figure, this being 73%.

[3] This is the number of pigs to be found in the area at any one time: in fact, assuming a threefold turnover, 1,200 pigs annually would be reared. This has already been allowed for in the Gross Margin estimate.

7.3.5 In the case of cattle and sheep, column (1) of Table 7.3 shows the acreage that should be used per animal. This factor has been used, in conjunction with the present number of animals in the area, to arrive at the total acreage properly being used for livestock production (column (3)). It will be observed that,

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defined in this way for cattle and sheep, the acreage employed in the production of livestock and arable crops is 4,702 out of a total adjusted acreage of 5,130. Some understocking of available land is therefore revealed.

7.3.6 It will be noted that forage crops of the kind listed in Table 7.2 do not appear in Table 7.3. There is some difficulty in allocating the costs and benefits of forage crops; theoretically they should already be included in the Gross Margins specified in Table 7.3. For the purposes of this exercise, however, it is convenient to omit the cost of forage crops (currently £12,950) because it is assumed that the same quantity would be produced if relocation took place. As this figure would therefore appear on both sides of the calculation, we ignore it.

7.3.7 Fixed costs are estimated on the basis of average data provided by the Bristol and Exeter Universities' survey. These are shown in Table 7.4. For this purpose, acreage does not include rough grazing land. The average cost per acre quoted applies to farms falling in a category defined in the survey in which milk forms between 10% and 49% of the value of gross output, and in which the gross value of cattle and sheep is greater than that of crops. Fixed costs per acre are assumed to vary according to the size of holding, and the figure of £20·2 is estimated on the basis of the particular farming structure to be found in Area B.

TABLE 7.4

Area B: Existing Fixed Costs

Acreage			Average Cost Per Acre (£)	Total Cost (£)
Total	Rough Grazing	Other		
5,130	150	4,980	20·2	100,596

7.3.8 Payment for farmers' labour is summarised in Table 7.5: roughly speaking, the cost that would be incurred in employing labour to run the farm is based upon the acreage of the farm concerned.

TABLE 7.5

Area B: Payment for Farmers' Labour

Number of Farms	Viable or Non-Viable	Acreage Per Farm	Cost Per Farm (£)	Total Cost (£)
14	Non-Viable	<122	400	5,600
24	Viable	<122	650	15,600
7	"	122–179	850	5,950
3	"	180–244	1,000	3,000
5	"	>244	1,000	5,000
			Total	35,150

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7.3.9 The private and social returns (the latter defined as private returns less subsidies) annually obtained from agriculture in Area B are therefore estimated as follows:—

TABLE 7.6

Area B: Current Annual Output (£)

(*a*) Private Returns		(*b*) Social Returns	
Gross Margins	148,458	Gross Margins	148,458
		Minus Subsidies	42,177
			106,281
Minus Fixed Costs	100,596	*Minus* Fixed Costs	100,596
	47,862		5,685
Minus Farmers' Labour	35,150	*Minus* Farmers' Labour	35,150
Private Surplus	12,712	Social Net Value	—29,465

Farmers' profits of £12,712 annually, or an annual social deficit of £29,465, are therefore estimated to be the returns from agricultural output produced in the area if the water scheme goes ahead.

The Consequences of Relocation

7.3.10 Abandonment of farm properties for residential purposes would also entail the abandonment of certain types of farm production. This would normally apply to pigs and poultry and, most important of all in this area, to dairying. A general reason for the selection of these three forms of enterprise is that constant attention to the livestock is required, which may not always be possible if the farmer does not reside at the farm itself.

7.3.11 In extreme circumstances, the poor quality of an existing supply might *in itself* justify, on health grounds, the abandonment of dairy farming. Nevertheless, such conditions would be unusual, and it would certainly be inaccurate to imply that dairying should be discontinued just because the water is unfit for domestic use. Raw water may be unsuitable for both dairying and domestic purposes, but it may often be treated and rendered suitable for dairying to quality standards established and enforced by the Ministry of Agriculture, when similar procedures for domestic consumption are impracticable.[1] It may not, therefore, be inconsistent to permit dairying to continue while at the same time to forbid domestic consumption of such water. In the present exercise, however, this particular line of inquiry need be pursued no further, for although the existence of dairy farming in the study area is evidence that the water used for that purpose is considered suitable by the Ministry of Agriculture, sufficient

[1] A major reason for this is that the degree of chlorination needed to attain an acceptable standard for dairying purposes will often make the water unpalatable, without still further treatment, to the domestic consumer. In addition, the methods employed by the Ministry of Agriculture to enforce quality standards cannot readily be extended to the domestic user. That this is crucial is demonstrated by the way in which private domestic supplies are sometimes allowed to deteriorate. (See paragraphs 3.2.8 to 3.2.13.)

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reason for the abandonment of dairying is to be found in the distance farmers would have to travel between existing farms and the relocation sites.

7.3.12 Our treatment of the post-relocation situation in respect of agriculture differs from the remainder of the study in that we have tried to envisage what farmers would do, and what sort of farming pattern would emerge from farmers' reactions to the changes. With regard to the remainder of the activities examined in this study, our main concern is to estimate the cost of providing a service or maintaining a level of amenity after relocation similar to that which existed before: with a few minor exceptions, the prediction of human reactions to the new situation has been avoided. Even in this section it would be possible to estimate the cost of producing an output similar in quantity and quality to that existing before relocation took place, but this would imply continuing governmental interference in agriculture at individual farm level. Such a policy could be tolerated in respect of privately owned utilities such as bus companies, but it would be unrealistic to push this much further. Consequently, we have no escape from the hazardous task of predicting how farmers would adjust to the new situation: the profitability of farms would be the motive force behind the changes, although, of course, profitability is not used as a measure of social desirability.

7.3.13 Since dairying, pigs and poultry would no longer be possible lines of activity, small scale farming would have to be abandoned. Market forces would induce the amalgamation of farms, which might reasonably be expected to result in about ten holdings of between 400 and 500 acres each, although the precise number of holdings is not crucial to the exercise.

7.3.14 Beef and sheep would have to become the main enterprises, as there is not a great deal of scope for further expansion of arable crops in the area. Arable and forage acres would therefore probably remain unchanged. Most of the rough grazing mentioned above is at the western end of the area; it is presumed that farm sizes would be adjusted to make the most profitable use of this, although this again is not a crucial factor.

7.3.15 If cereals remained unchanged, the major effect would be that the 1,596 acres (nearly $\frac{1}{3}$ of the area) at present used by dairy cows and replacements would be restocked with beef cows and sheep. In addition, it might be expected that a consequence of amalgamation into larger units would permit more intensive usage of available land and improve the stocking rate. It is estimated that at present the equivalent of 428 acres is understocked, and in the following calculations it is assumed that this would be remedied in the post-relocation situation.

7.3.16 A total of 2,024 acres would therefore now be used by beef cows and sheep. The sensible (i.e. profit-maximising) solution would not be to stock this acreage entirely with beef or entirely with sheep. The land previously used for dairy cows could best be utilised, because of the differential grazing requirements over the year of beef cows and sheep, in the proportion of one beef cow plus six ewes (and lambs) to every three acres. This arrangement would provide a Gross

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Margin of £22 per acre and entail exchequer support of £10·36 per acre, giving totals of £44,528 and £20,969 respectively. It is assumed that the output from the remaining acres used for livestock production remains unchanged.

7.3.17 The fixed costs that might be expected to be incurred by farms of this nature and size have been estimated at £17 per acre on land other than rough grazing. The presumption is that there will be economies of scale in the use of labour, machinery, etc., not available to the bulk of farms currently being operated in Area B. The cost of farmers' labour required to run the ten large farms in the new situation is estimated at £1,000 for each farm, a total of £10,000 for the area. Again, this figure represents the amount it would cost to employ a farm manager to run the new holdings.

7.3.18 Finally, an important adjustment has to be made in respect of the value of milk produced under the present system, and the loss that would follow from the abandonment of dairying in the South Atcham area. The data listed in Table 7.1 are average figures, which are satisfactory as long as they do not diverge from marginal values. However, should dairying be abandoned in a relatively small agricultural area such as the one presently being examined, the social net loss per gallon would be a considerably smaller figure than the average social net value per gallon of milk produced over the country as a whole.

7.3.19 The reason for this is to be found in the discriminatory pricing system operated by the Milk Marketing Board, in which the liquid market price is higher than the price of milk sold for manufacturing purposes. Most milk is offered for sale in the liquid market, the residual being taken up by the manufacturing market. Nevertheless, each milk producer receives a common 'pool' price, which reflects the relative quantities of milk sold in the two markets, and which is therefore higher than the price realised from the sale of milk to manufacturers. The pool price is used in the calculation of average Gross Margins in Table 7.1, the manufacturing and pool prices for the years 1963/4 to 1966/7 being as follows:—

TABLE 7.7

Milk Prices (England and Wales) (pence per gallon)

1963/4–1966/7[1]

	Net Price ex Farm: Wholesale Producers	Average Prices Realised for Manufactured Milk
1963/4	34·78	20·14
1964/5	37·68	22·24
1965/6	38·03	22·17
1966/7	39·10	22·63
Unweighted Average	37·40	21·80

[1] Source: *U.K. Dairy Facts and Figures*, 1965, 1966 *and* 1967, Federation of U.K. Milk Marketing Boards.

7.3.20 The effect of abandoning dairying in South Atcham would be to reduce the total amount of milk produced in the country. Consequently, as the manu-

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facturing market merely takes what the liquid market cannot absorb, the *overall* sales of milk for manufacturing purposes can be expected to fall by an amount equal to the quantity of milk produced in South Atcham multiplied by the manufacturing price (i.e. roughly 21·8 pence per gallon). Although producers in South Atcham may currently supply milk for the liquid market, abandonment of dairying in this area would mean that some of the milk now produced outside the area for manufacturing purposes could be switched to the liquid market, for ultimately the least valuable market would be the one most likely to be affected by the change.

7.3.21 In estimating the social returns accruing from relocation, therefore, an adjustment has to be made to the value of milk produced in the South Atcham area. In comparing the pre- and post-relocation situations, the use of the pool price as a basis for valuing the existing system will understate the advantages to be gained from the cessation of milk production. The Gross Margin for dairy cows quoted in Table 7.1 includes a figure for milk sales at a price of roughly 37·4 pence per gallon whereas, as we have noted, the real cost of abandonment should be based on a figure of 21·8 pence per gallon. Assuming an annual average of some 800 gallons per cow, the net social value of milk production is thereby reduced by £52 per cow per annum. Since in Area B there are 659 dairy cows, the net social return from agricultural production is reduced by £34,268 annually, i.e. from —£29,465 to —£63,733.

7.3.22 Allowing for changes in Gross Margins, exchequer support, fixed costs, farmers' labour, and making the milk price adjustment just described, the annual costs and benefits of relocation for Area B are estimated as follows:—

TABLE 7.8

Area B: Annual Output After Relocation (£)

(a) Private Returns

Present Gross Margins...	148,458
Minus loss on dairy cattle, pigs and poultry	70,645
	77,813
Plus Replacement Margins	44,528
New Gross Margins	122,341
Minus New Fixed Costs	84,660
	37,681
Minus Farmers' Labour	10,000
New Private Surplus	27,681
Present Private Surplus	12,712
Annual Private Gain from Relocation	14,969

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TABLE 7.8—*continued*
(b) Social Returns

Present Gross Margins, less subsidies	106,281
Minus loss on dairy cattle, etc., less subsidies	63,114
	43,167
Plus Replacement Margins, less subsidies	23,559
	66,726
Minus New Fixed Costs	84,660
	− 17,934
Minus Farmers' Labour	10,000
New Net Social Return	− 27,934
Present Net Social Return	− 63,733
Annual Social Net Gain from Relocation	35,799

7.3.23 Relocation would therefore produce an increase in farm profits of £14,969, but the total surplus of £27,681 would be divided among only ten farms, for 29 occupiers would be made redundant. The annual social net gain, in which we are most interested, is £35,799. Although in practice there would be a time lag before the new farming system came into being in its entirety, we assume that these effects would begin at t_0.

7.3.24 Certain adjustments have to be made to the annual figures listed in Table 7.8, but these apply only to t_0 and t_1. First, there would be a once-for-all cost at t_0: this is the expenditure on new buildings, or conversion of existing ones, that would be necessary to enable the new holdings to be worked at a distance. An estimated capital cost of £5,000 per farm would be required, making a total of £50,000 for the area. This would be equally applicable to both the private and social calculations. Theoretically, some double-counting could be involved here, since fixed costs are supposed to include an element of building costs. However, these are usually so small that this is not a serious criticism.

7.3.25 Secondly, the revised farming system would make 49 out of the total labour force (employers plus employees) redundant. The ten new holdings would only require about 25 employees, making a total of 35 people continuing in agricultural production in the area. It is probable that there would be a time lag before the whole of the displaced labour force could find alternative employment. The importance of this is that if a redundant worker cannot obtain alternative employment, his current employment involves no opportunity cost: he has no value in alternative forms of production, and so although he can command a wage in his present employment, this does not represent a cost to society as a whole, although it clearly does, privately, to his employer.

7.3.26 We have in fact postulated a two-year lag before all the redundant workers obtain alternative employment, one-third obtaining employment during the period covered by t_0, a further third by t_1 and the rest by t_2. In other words,

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if the present system continued, the employment of one-third of the labour force would have an opportunity cost the whole time, one-third would have an opportunity cost for all but the first year and one-third for all but the first two years following a given base year. (Strictly speaking, we would be entitled to assume that if potentially redundant workers have no opportunity cost, nor do some of the retained workers. It is not necessary to make allowance for this, however, because to do so would only entail deducting the same amount from the calculations applying to both the pre- and post-relocation situations at t_0 and t_1.)

7.3.27 Assuming that ten farmers with imputed returns from their labour of £850 and over retain control of farms in the area, the accounting cost of employing workers who would become redundant can be taken as being £600 per head per annum, the standard agricultural labourer's wage. The possibility of re-employment difficulties is incorporated in Table 7.9(A), which also allows for the cost of new buildings required by relocation.

TABLE 7.9(A)

Adjusted Social Net Value of Farm Output
(2-year Re-employment Lag) (£)
Summary Table: Area B

Year	Net Value: Existing System	Net Value: Revised System	Net Cost of Relocation
t_0	− 44,533	− 77,934	33,401
t_1	− 54,133	− 27,934	− 26,199
t_2–t_{30}	− 63,733	− 27,934	− 35,799

7.3.28 The two-year lag assumption is somewhat conjectural, there being no precedent for the sort of situation proposed in this study. As an alternative, therefore, Table 7.9(B) shows the adjusted social net value of farm output on the assumption that all redundant farmworkers immediately obtain employment elsewhere. In these circumstances the accounting cost of employing farmworkers would roughly equal the social cost of doing so.

TABLE 7.9(B)

Adjusted Social Net Value of Farm Output
(No Re-employment Lag) (£)
Summary Table: Area B

Year	Net Value: Existing System	Net Value: Revised System	Net Cost of Relocation
t_0	− 63,733	− 77,934	14,201
t_1–t_{30}	− 63,733	− 27,934	− 35,799

7.3.29 It will be noted that under both assumptions the annual value of output remains unchanged over the bulk of the period. This is most unlikely, but we have no information that suggests a more realistic alternative. Quite apart from

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technological advances, changes in government policy in terms of price support schemes and import controls are clearly of fundamental importance in determining the accuracy of the figures presented in Tables 7.9(A) and 7.9(B).

7.3.30 To take an example of current interest, a ban on beef imports from Argentina would make a switch of the sort envisaged in the present study, from dairy to beef cattle, a much more favourable influence in determining the merits of relocation than it is now. Currently, relocation is seen to be likely to encourage the substitution of heavily subsidised for lightly subsidised forms of production. In *social* cost-benefit terms, the existence of agricultural subsidies imparts a bias in favour of dairying as opposed to beef and sheep production; in a dairying area, therefore, there would be a bias in favour of retention of the existing farming system. We have not had occasion in this study to allow for hill-farming subsidies, as only a minute portion of the study area reaches the required altitude. It may be that in other areas in which a study of the present kind might be carried out, some farms may owe their existence to substantial hill-farming subsidies. In these circumstances exchequer support for agriculture might enhance the case for relocation.

Current Output—Area C

7.3.31 Area C contains 1,510 acres of agricultural land, of which 469 consist of rough grazing. Estimating rough grazing in this area as the equivalent of 0·4 acres of other land, the total adjusted acreage is 1,229. There are currently about fifteen persons employed full-time in the area, the total number of holdings being twelve, of which four are non-viable. The number of full-time employees is seven.

7.3.32 Current land use, output, fixed costs and payment for farmers' labour are shown in Tables 7.10 to 7.13. The definitions employed in Tables 7.10, 7.11 and 7.13 are as for Tables 7.2, 7.3 and 7.5. The fixed costs per acre given in Table 7.12 relate to mixed farms with milk comprising between 50% and 69% of gross output, into which category falls the type of farm to be found in Area C.

TABLE 7.10

Land Use: Area C

Forage	
Turnips, swedes, etc.	10 acres
Mangolds	3
Kale	7
Temporary Grass	185
Permanent Grass	597
Rough Grazing (adjusted)	188
Bare Fallow	2
Arable	237
Total Acreage	1,229

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TABLE 7.11

Area C: Current Farm Output

(a) Livestock

	Standard Acres Per Unit (1)	Present Number (2)	Acres (3)	Total Gross Margins (£) (4)	Exchequer Support (£) (5)	Gross Margins less Exchequer Support (£) (6)
Dairy Cattle						
Dairy Cows ...	1·9	203	386	17,052	853	16,199
Dairy replacements ...	2·0	50	100	2,750	165	2,585
Other Cattle						
Beef Cows ...	1·9	37	70	888	373	515
Heifers < 1 yr. ...	0·4	62	25			
Steers < 1 yr. ...	0·4	37	15	2,805	2,048	757
Heifers 1–2 yrs. ...	0·8	58	46			
Steers 1–2 yrs. ...	0·8	30	24			
Calves reared and sold during winter	0·1	100	10	600	—	600
Sheep						
Ewes and lambs...	0·3	1,271	381	8,897	4,449	4,448
Pigs						
Breeding	—	15	—	285	28	257
Fattening ...	—	40	—	160	224	— 64
Poultry						
Layers	—	824	—	206	206	—

(b) Arable

Wheat	—	—	53	1,749	437	1,312
Barley	—	—	169	4,732	1,420	3,312
Potatoes	—	—	15	1,200	144	1,056
		Total	1,294	41,324	10,347	30,977

TABLE 7.12

Area C: Existing Fixed Costs

Acreage			Average Cost Per Acre (£)	Total Cost (£)
Total	Rough Grazing	Other		
1,229	188	1,041	27·4	28,523

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TABLE 7.13
Area C: Payment for Farmers' Labour

Number of Farms	Viable or Non-Viable	Acreage Per Farm	Cost Per Farm (£)	Total Cost (£)
4	Non-Viable	< 122	400	1,600
5	Viable	< 122	650	3,250
3	,,	122–244	1,000	3,000
			Total	7,850

7.3.33 Private and social returns annually obtained from agriculture in Area C under present conditions are therefore estimated as in Table 7.14.

TABLE 7.14
Area C: Current Annual Output (£)

(a) Private Returns		(b) Social Returns	
Gross Margins	41,324	Gross Margins	41,324
		Minus Subsidies	10,347
			30,977
Minus Fixed Costs	28,523	*Minus* Fixed Costs	28,523
	12,801		2,454
Minus Farmers' Labour... ...	7,850	*Minus* Farmers' Labour	7,850
Private Surplus	4,951	Social Net Value	− 5,396

Current returns from agricultural output in Area C are therefore estimated as an annual profit to farmers of £4,951, or a net social loss of £5,396.

The Consequences of Relocation

7.3.34 It is envisaged that, as in Area B, relocation would mean that dairy farming would be replaced by beef and sheep, arable acreage remaining unchanged. Amalgamation of holdings would again be required for profitable farming to be possible, and the following calculations are based on the assumption that three farms, each of about 400 (adjusted) acres, of which 50 would be grazing land, would emerge. Geographically these acreages might not prove practicable, but for calculation of the value of output this would not greatly affect the result.

7.3.35 Use of the standard acreage figures for livestock indicates a degree of overstocking in the area, but this is very slight. Ignoring this, relocation would therefore mean transferring the 486 acres currently devoted to dairy cattle to the production of beef and sheep. Using the restocking combination suggested for Area B, this form of production would yield Gross Margins of £10,692 and receive exchequer support of £5,035. Fixed costs, given the size and type of farms that would result in the area, are estimated at £20 per acre, making a total of

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£20,820. Farmers' labour is estimated to cost £1,000 per farm, a total of £3,000 for the area.

7.3.36 The estimated annual value and costs of output should relocation take place are shown in Table 7.15. It will be noted that the annual social net value of current output is reduced from —£5,396 to —£15,952 as a result of adjusting the value of milk production in the area.

TABLE 7.15
Area C: Annual Output After Relocation (£)
(a) Private Returns

Present Gross Margins	41,324
Minus loss on dairy cattle, pigs and poultry	20,453
	20,871
Plus Replacement Margins	10,692
New Gross Margins	31,563
Minus New Fixed Costs	20,820
	10,743
Minus Farmers' Labour	3,000
New Private Surplus...	7,743
Present Private Surplus	4,951
Annual Private Gain from Relocation	2,792

(b) Social Returns

Present Gross Margins, less subsidies	30,977
Minus loss on dairy cattle, etc., less subsidies	18,977
	12,000
Plus Replacement Margins, less subsidies...	5,657
	17,657
Minus New Fixed Costs	20,820
	— 3,163
Minus Farmers' Labour	3,000
New Net Social Return	— 6,163
Present Net Social Return	—15,952
Annual Social Net Gain from Relocation	9,789

7.3.37 Relocation would therefore mean a net social gain of £9,789 annually, but farm profits would increase by only £2,792, this being shared among only three farms, the occupiers of the other five viable holdings being displaced. Total redundancy in the area would be six out of the existing labour force of fifteen. The same two assumptions are made concerning the time lag between redundancy and re-employment, as in Area B. Allowing for this, and for the cost of new buildings, estimated at £5,000 per farm, the effects of relocation are summarised in Tables 7.16(A) and 7.16(B):

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TABLE 7.16(A)

Adjusted Social Net Value of Farm Output

(2-Year Re-employment Lag) (£)

Summary Table: Area C

Year	Net Value: Existing System	Net Value: Revised System	Net Cost of Relocation
t_0	− 13,552	− 21,163	7,611
t_1	− 14,752	− 6,163	− 8,589
t_2–t_{30}	− 15,952	− 6,163	− 9,789

TABLE 7.16(B)

Adjusted Social Net Value of Farm Output

(No Re-employment Lag) (£)

Summary Table: Area C

Year	Net Value: Existing System	Net Value: Revised System	Net Cost of Relocation
t_0	− 15,952	− 21,163	5,211
t_1–t_{30}	− 15,952	− 6,163	− 9,789

Current Output—Area D

7.3.38 There are 4,798 acres of agricultural land in Area D, of which 91 consist of rough grazing land. Total adjusted acreage is approximately 4,743. There are at present 45 holdings in the area, of which 39 are viable, the number of people fully employed in agriculture being 74.

7.3.39 Current land use, output, fixed costs and payment for farmers' labour are shown in the following tables. Fixed costs are estimated as for Area B, i.e. on the basis of milk production being between 10% and 49% of the value of gross output, with the value of cattle and sheep being greater than that of crops.

TABLE 7.17

Land Use: Area D

	Acres
Forage	
Turnips, Swedes, etc.	43
Mangolds	20
Kale	24
Temporary Grass	654
Permanent Grass	2,156
Rough Grazing (adjusted)	36
Bare Fallow	45
Arable	1,765
Total Acreage	4,743

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TABLE 7.18

Area D: Current Farm Output

(a) Livestock

	Standard Acres Per Unit (1)	Present Number (2)	Acres (3)	Total Gross Margins (£) (4)	Exchequer Support (£) (5)	Gross Margins less Exchequer Support (£) (6)
Dairy Cattle						
Dairy Cows ...	1·9	477	906	40,068	2,003	38,065
Dairy Replacements ...	2·0	227	454	12,485	749	11,736
Other Cattle						
Beef Cows ...	1·9	97	184	2,328	978	1,350
Heifers < 1 yr. ...	0·4	169	68			
Steers < 1 yr. ...	0·4	364	146	11,820	8,629	3,191
Heifers 1–2 yrs. ...	0·8	42	34			
Steers 1–2 yrs. ...	0·8	213	170			
Calves reared and sold during winter	0·1	150	15	900	—	900
Sheep						
Ewes and lambs ...	0·3	1,064	319	7,448	3,724	3,724
Wintered lambs ...	0·1	400	40	800	400	400
Pigs						
Breeding	—	115	—	2,185	218	1,967
Fattening	—	366	—	1,464	2,050	− 586
Poultry						
Layers	—	2,870	—	717	717	—

(b) Arable

Wheat	—	—	490	16,170	4,042	12,128
Barley	—	—	1,110	31,080	9,324	21,756
Oats	—	—	146	3,504	1,472	2,032
Sugar Beet	—	—	15	900	54	846
Potatoes	—	—	4	320	38	282
		Total	4,101	132,189	34,398	97,791

TABLE 7.19

Area D: Existing Fixed Costs

Acreage			Average Cost Per Acre (£)	Total Cost (£)
Total	Rough Grazing	Other		
4,743	36	4,707	19·5	91,787

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TABLE 7.20
Area D: Payment for Farmers' Labour

Number of Farms	Viable or Non-Viable	Acreage Per Farm	Cost Per Farm (£)	Total Cost (£)
9	Non-Viable	< 122	400	3,600
27	Viable	< 122	650	17,550
4	,,	122–180	850	3,400
5	,,	> 180	1,000	5,000
			Total	29,550

TABLE 7.21
Area D: Current Annual Output

(a) Private Returns		(b) Social Returns	
Gross Margins	132,189	Gross Margins	132,189
		Minus Subsidies	34,398
			97,791
Minus Fixed Costs	91,787	*Minus* Fixed Costs	91,787
	40,402		6,004
Minus Farmers' Labour... ...	29,550	*Minus* Farmers' Labour	29,550
Private Surplus	10,852	Social Net Value	−23,546

Current returns from agricultural output are therefore an annual profit to farmers of £10,852, or a social loss of £23,546.

The Consequences of Relocation

7.3.40 Should relocation proceed, it is assumed that the same sort of changes would take place as in Areas B and C. Amalgamation would certainly be necessary if farming is to be carried on throughout the whole area, and regrouping into seven holdings of between 600 and 650 acres would be a feasible result.

7.3.41 The standard acreage data reveal that the equivalent of 642 acres is understocked. As in the case of Area B, it is presumed that this would be remedied upon the amalgamation of farms into larger units. Beef cows and sheep, in the proportions suggested for the other two areas, would be used to stock the 1,360 acres vacated by dairy cattle and the 642 acres presently understocked. This would yield Gross Margins of £44,044 and attract subsidies of £20,741. It is assumed as before that arable acreage would remain unchanged.

7.3.42 Fixed costs for the seven new farms are estimated at £18 per acre, making a total of £84,726. It is not surprising that this figure is smaller than the estimate for the new holdings in Area C (£20). The farms in D may be about twice the size of those in C and may therefore allow economies of scale to be achieved. On the other hand, the farms are also larger than those in B, for which

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a fixed cost of only £17 per acre was estimated, but this can be explained by the higher proportion of acreage devoted to arable farming in D than in B (37% as opposed to 23%), and fixed costs per acre are higher for arable than for livestock farming. Farmers' labour, as in the other areas, is reckoned at £1,000 per farm, making a total of £7,000 for this area.

7.3.43 The effects of relocation are now summarised in Table 7.22, in which the adjustment that has to be made to the price of milk is seen to increase the aggregate social loss on existing output from £23,546 to £48,350 annually.

TABLE 7.22
Area D: Annual Output After Relocation (£)

(a) Private Returns	
Present Gross Margins...	132,189
Minus loss on dairy cattle, pigs and poultry	56,919
	75,270
Plus Replacement Margins	44,044
New Gross Margins	119,314
Minus New Fixed Costs	84,726
	34,588
Minus Farmers' Labour	7,000
New Private Surplus	27,588
Present Private Surplus	10,852
Annual Private Gain from Relocation	16,736
(b) Social Returns	
Present Gross Margins, less subsidies	97,791
Minus loss on dairy cattle, etc., less subsidies	51,182
	46,609
Plus Replacement Margins, less subsidies	23,303
	69,912
Minus New Fixed Costs	84,726
	− 14,814
Minus Farmers' Labour	7,000
New Net Social Return	− 21,814
Present Net Social Return	− 48,350
Annual Social Net Gain from Relocation	26,536

7.3.44 The seven farms remaining in Area D would therefore share the total profits made in the area, which are estimated to increase by £16,736 annually. Relocation also produces a net social gain of £26,536 per annum. The cost of the new buildings necessary for the revised farming system to be carried on is estimated at £5,000 per holding, or £35,000 for the whole area. Allowing for this, and on the assumption that amalgamation would make 47 out of the 74 full-time farmworkers in the area redundant, with similar re-employment

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problems to those already outlined, the adjusted annual figures are shown in Tables 7.23(A) and 7.23(B).

TABLE 7.23(A)

Adjusted Social Net Value of Farm Output
(2-Year Re-employment Lag) (£)
Summary Table: Area D

Year	Net Value: Existing System	Net Value: Revised System	Net Cost of Relocation
t_0	− 29,150	− 56,814	27,664
t_1	− 38,750	− 21,814	− 16,936
t_2–t_{30}	− 48,350	− 21,814	− 26,536

TABLE 7.23(B)

Adjusted Social Net Value of Farm Output
(No Re-employment Lag) (£)
Summary Table: Area D

Year	Net Value: Existing System	Net Value: Revised System	Net Cost of Relocation
t_0	− 48,350	− 56,814	8,464
t_1–t_{30}	− 48,350	− 21,814	− 26,536

7.4. Summary

7.4.1 In aggregate, relocation would result in additional net income (i.e. returns over and above payment for farmers' labour) for persons currently occupying farms in the study area. Assuming that the wage rate that has been imputed to displaced farm occupiers is a reasonable measure of the wage they could command in alternative employment, the net private benefit from relocation is given in Table 7.24. At t_0, the expenditure on new buildings offsets the gain in net income from the revised farming system (this could of course be expressed as an annual-equivalent sum), but from then on net gains accrue. The loss in income occasioned by the temporary period of unemployment of displaced farmers is ignored. This would not affect the result greatly, for as far as they are concerned, as individuals, the loss in income from their labour (on average, about £650) would be offset to some extent by welfare payments. The present value equivalent sums at various discount rates of the aggregate gains accruing to existing decision-makers in agriculture are given in Table 7.25.

TABLE 7.24

Net Private Gain from Relocation: Agriculture (£)

Year	B	C	D
t_0	− 35,031	− 12,208	− 18,264
t_1–t_{30}	14,969	2,792	16,736

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TABLE 7.25

Present Worth of Private Gains from Relocation (£)

Discount Rate	B	C	D
6%	171,015	26,223	212,104
8%	133,487	19,224	170,146
10%	106,080	14,112	139,505
12%	85,547	10,282	116,548

7.4.2 In a perfectly functioning market economy, changes of the nature suggested in this chapter would therefore tend to take place without the stimulus brought about by depopulation. Under normal circumstances, such changes could also involve amalgamation into larger *dairy* units should there be no problems concerning the adequacy of water supplies for dairy farming.

7.4.3 Tables 7.26(A) and 7.26(B) now show the net social gains or losses that would annually accrue as a result of relocating the various combinations of areas. The general picture is of initial net costs due to the construction of new buildings and, where applicable, the influence of the redundancy assumptions, followed by annual savings in the succeeding period. Inspection of these tables indicates that the overall effect of relocation would be a considerable net saving for each area or combination of areas.

TABLE 7.26(A)

Net Social Cost of Relocation: Agriculture

(2-Year Re-employment Lag) (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0	33,401	7,611	27,664	41,012	61,065	35,275	68,676
t_1	− 26,199	− 8,589	− 16,936	− 34,788	− 43,135	− 25,525	− 51,724
t_2–t_{30}	− 35,799	− 9,789	− 26,536	− 45,588	− 62,335	− 36,325	− 72,124

TABLE 7.26(B)

(No Re-employment Lag) (£)

Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0	14,201	5,211	8,464	19,412	22,665	13,675	27,876
t_1–t_{30}	− 35,799	− 9,789	− 26,536	− 45,588	− 62,335	− 36,325	− 72,124

7.4.4 The above shows the cost or savings relative to the situation in which no relocation takes place. In total, however, it is important to note that agricultural production shows a net social loss for *all* possible alternatives, including that in which the *status quo* is retained. The details are given in Tables 7.27(A) and 7.27(B).

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TABLE 7.27(A)

Agriculture: Total Social Cost (£)

(2-Year Re-employment Lag)

Year	*Area Relocated*							
	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0	87,235	120,636	94,846	114,899	128,247	148,300	122,510	155,911
t_1	107,635	81,436	99,046	90,699	72,847	64,500	82,110	55,911
t_2–t_{30}	128,035	92,236	118,246	101,499	82,447	65,700	91,710	55,911

Present Worth Equivalent

Discount Rate	None	B	C	D	B + C	B + D	C + D	B + C + D
6%	1,830,043	1,379,899	1,704,093	1,501,620	1,253,949	1,051,476	1,375,670	925,526
8%	1,509,887	1,149,083	1,408,383	1,247,648	1,047,579	886,844	1,146,144	785,340
10%	1,275,884	980,433	1,192,273	1,062,046	896,822	766,595	978,435	682,984
12%	1,100,690	854,130	1,030,470	923,054	783,910	676,494	852,834	606,274

TABLE 7.27(B)

(No Re-employment Lag)

Year	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0	128,035	142,236	133,246	136,499	147,447	150,700	141,710	155,911
t_1–t_{30}	128,035	92,236	118,246	101,499	82,447	65,700	91,710	55,911

Present Worth Equivalent

Discount Rate	None	B	C	D	B + C	B + D	C + D	B + C + D
6%	1,890,089	1,411,688	1,760,607	1,533,409	1,282,206	1,055,008	1,403,927	925,526
8%	1,569,575	1,180,683	1,464,560	1,279,248	1,075,668	890,356	1,174,233	785,340
10%	1,335,230	1,011,851	1,248,128	1,093,464	924,749	770,085	1,006,362	682,984
12%	1,159,704	885,373	1,086,013	954,297	811,682	679,966	880,606	606,274

7.4.5 An alternative solution might therefore be for agriculture to be abandoned altogether, but this raises questions beyond the scope of this exercise. To abandon agriculture because a social cost-benefit study showed it to be 'unprofitable' in terms of the way in which we have defined costs and benefits would bring us into conflict with general governmental policy in respect of agricultural support. We therefore accept the constraint that farming would be allowed to proceed, even though a social loss would result, but show the relative cost of so doing in terms of the value of goods produced and resources used up for the various relocation solutions.

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8. Sewage Disposal

8.1. Existing Methods of Disposal

8.1.1 At present, the only main drainage facilities in the study area are small, old-fashioned and unsatisfactory constructions to be found in Condover, Dorrington and Acton Burnell. There is no main drainage in Areas B, C or D, and in these districts, in company with those households in Area A not connected to existing facilities, reliance is placed upon septic tanks and other means of disposal which, like the water supply facilities, are of varying degrees of adequacy.

8.1.2 The sewage authority for the study area, the Atcham R.D.C., has no plans for extending main drainage to B, C or D, but there are plans to replace the systems now existing in Area A by two new schemes. The major scheme may take the form of the construction of a sewer between Leebotwood to Dorrington and then to Shrewsbury, where it could be disposed of at sewage works belonging to the Shrewsbury Borough Council. Alternatively, the sewage would be pumped from Dorrington to an existing R.D.C. sewage works at Brompton, near the village of Cross Houses. For the purpose of calculation, it is assumed that the alternative which involves pumping to Shrewsbury will be chosen. In either case, sewage would flow by gravity from Longnor and Condover to the main sewer. A smaller scheme is planned for Acton Burnell village, the sewage being dealt with at a local sewage works.

8.2. Public Health

8.2.1 As in the case of water supply, it is necessary to look at sewage disposal facilities in the light of health requirements. In fact, it appears that the main health hazard arising from inadequate means of sewage disposal is due to the polluting effect this might have on privately abstracted water supplies. Should mains supplies be laid on, therefore, the health hazard arising from inadequate sewage facilities would be considerably reduced. On the other hand, the provision of mains supplies would almost certainly increase the quantity of water consumed by households in the area, and the need for satisfactory means of disposing of waste water would increase on that account.

8.2.2 As in the case of water supply, no attempt has been made to quantify the health risk that would remain should existing standards of waste disposal persist in the area. However, whereas for water supply this left us with a choice between providing mains supplies or rehousing, in the case of sewage disposal facilities for rural dwellers, the alternative is the provision of main drainage or the construction of individual septic tanks. Now, septic tanks are obviously not an entirely satisfactory method of waste disposal but, built to a certain specification, and subject to regular emptying, they are accepted by the health authorities as being adequate, and we too (again with no evidence to support their 'adequacy'), have accepted this. The use of septic tanks is, however, limited to properties which are fairly isolated; we have also accepted the advice of

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public health authorities that the relocation solutions, involving the regrouping of households in concentrated settlements, would require, on health grounds, the construction of, or attachment to, a main drainage system.

8.3. Main Drainage

8.3.1 The results are therefore affected greatly by the planned main drainage schemes for Area A. For now relocation merely involves the cost of connecting the additional properties to the sewers. Without the planned scheme relocation, to be consistent with generally accepted health requirements, would *require* the construction of such a system because of the greater proximity of houses to each other. Relocation in many situations might therefore show a net cost, whereas in our example it shows a net benefit, as the following tables bear out. We look first at the estimated capital and running costs of main drainage schemes, appropriate to the various relocation possibilities.

TABLE 8.1

Main Drainage Costs (£)

Area Relocated (1)	Main Scheme: Initial Cost (2)	Acton Burnell Scheme: Initial Cost (3)	Annual Running Costs (4)
None	195,000	21,500	3,500
B	196,000	23,500	3,600
C	195,000	21,500	3,500
D	195,000	24,500	3,600
B + C	197,000	23,500	3,600
B + D	197,000	25,000	3,800
C + D	195,000	24,500	3,600
B + C + D	198,000	25,000	4,000

8.3.2 From this table it will be observed that economies of scale, particularly with respect to capital costs, are very significant. For example, the estimated number of properties to be served by the scheme in Area A is 436, and the cost of this, in the absence of relocation, would be £216,500 (columns (2) + (3)). For an additional outlay of only £6,500 (£3,500 on the Acton Burnell scheme and £3,000 on the major one) an additional 265 properties can be accommodated, reducing the cost per property served by main drainage from £496 to £309. (The cost of connecting individual households to main drainage, approximately £30 per house, is not included in this estimate, as it appears elsewhere.[1])

8.3.3 Annual running costs, too, demonstrate economies of scale, for they rise from £3,500 to only £4,000 as a result of B + C + D being relocated. These costs can be divided into two groups. First, there are those which are incurred directly by the Atcham R.D.C. and which are largely comprised of expenditure on vehicles and pumping, the capital and replacement cost of such equipment here being calculated as an annual flow. These costs vary hardly at all with the quantity of sewage passing through the system. The remainder of the annual

[1] See paragraph 15.3.11.

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cost figure is comprised of payments made by Atcham R.D.C. to Shrewsbury Borough for treating and disposing of the sewage, the annual sum being based upon the rateable value of properties connected to the main drainage system and, as such, there is a rough relationship between cost and quantity. In the absence of detailed information, we have used this figure as representing the real cost of connecting additional properties to the system, the cost in this case being the burden placed upon the capacity of sewage works at Shrewsbury, plus the cost of treatment and disposal by the Shrewsbury sewerage authority.

8.3.4 We have already postulated an increase over time in water consumption, and estimated the appropriate annual cost figures. It is reasonable to assume that the rate of growth in water consumption would be matched by a similar rate of growth in the quantity of waste water to be disposed of. In view of the small variation in costs resulting from changes in the rate of flow, however, no estimate was made of this trend, the cost figures for the current year being retained for all subsequent years.

8.4. Septic Tanks

8.4.1 It is clear from the foregoing that in view of the considerable economies of scale to be achieved, the existence (or planned existence) or otherwise of a main drainage scheme in the area chosen for relocation is crucial in determining whether or not relocation would show a net benefit on the sewage disposal account. Disposal of waste by the use of septic tanks is a very different proposition, however, the cost of their provision under the various relocation possibilities being summarised in Table 8.2.

TABLE 8.2

Cost of Septic Tanks

Area Relocated	Number of Properties Remaining with Inadequate Disposal Facilities	Initial Cost of Septic Tanks (£)	Annual Operating Costs (£)
None	112	33,600	3,445
B	64	19,200	1,781
C	90	27,000	2,717
D	70	21,000	2,392
B + C	42	12,600	1,053
B + D	22	6,600	728
C + D	48	14,400	1,664
B + C + D	—	—	—

8.4.2 A recent survey carried out by the Atcham R.D.C. showed that in Area B there were 48 properties without adequate sewage disposal facilities, while in C there were 22 and in D, 42. The cost of constructing a satisfactory septic tank has been estimated at £300 per property: upon relocation of any area, therefore, this figure has simply been multiplied by the number of unsatisfactory premises remaining in areas that are not depopulated. Thus, if B + C + D are depopulated, there will be no need for septic tanks at all.

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8.4.3 Annual running costs consist of expenditure on the vehicles, plant and labour required to empty septic tanks twice a year, and to dispose of the contents. As a rule of thumb guide, the annual average cost of providing this service (roughly £13) to those households in Atcham R.D. that currently take advantage of it is taken as being the average cost of providing it for the new owners of septic tanks, as well as for those households in Areas B, C and D which already have satisfactory means of waste disposal. (To the extent that there may be economies of scale here, we are probably slightly overstating the annual cost of septic tanks.)

8.4.4 It is necessary in this context to make the same kind of assumption as in the case of connection to the water mains, in that even though householders in this position may not voluntarily pay for the installation of septic tanks or pay the R.D.C. to empty them twice yearly, our calculations must be based on the assumption that they do so. This is mainly for the reason that, in demonstrating the relative cost of providing services in scattered and concentrated settlements, we want to retain, as far as possible, the same standard of service. It is considered that regular emptying of septic tanks is necessary if this method of waste disposal is to be at all comparable, in terms of public health and the avoidance of nuisance, to the use of a main drainage system.

8.5. Summary

8.5.1 Table 8.3 now shows the cost of sewage disposal for the various relocation alternatives, including expenditure on the main drainage schemes and, where applicable, on septic tanks.

TABLE 8.3

Costs of Sewage Disposal: Main Drainage and Septic Tanks (£)

Year	*Area Relocated*							
	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0	257,045	244,081	249,717	246,492	237,753	233,128	239,164	227,000
t_1–t_{30}	6,945	5,381	6,217	5,992	4,653	4,528	5,264	4,000

Present Worth Equivalent

Discount Rate	None	B	C	D	B + C	B + D	C + D	B + C + D
6%	352,642	318,150	335,293	328,971	301,801	295,455	311,622	282,059
8%	335,230	304,659	319,707	313,949	290,135	284,103	298,426	272,031
10%	322,515	294,807	308,324	302,978	281,616	275,813	288,787	264,708
12%	312,988	287,426	299,796	294,759	275,234	269,602	281,567	259,221

8.5.2 Finally, Table 8.4 provides estimates of the net savings achieved through relocation, both in aggregate and per property relocated. It will be noted that the sum of the aggregate savings for individual areas does not always equal the aggregate savings achieved should a combination of those areas be relocated.

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TABLE 8.4

Net Savings Resulting from Relocation: Sewage Disposal (£)

Area Relocated	*Aggregate*		*Per Property*	
	Saving on Initial Outlay[1]	Annual Saving	Saving on Initial Outlay[1]	Annual Saving
B	11,400	1,564	89	12
C	6,600	728	118	13
D	9,600	953	119	12
B + C	17,000	2,292	92	12
B + D	21,500	2,417	103	12
C + D	16,200	1,681	118	12
B + C + D	27,100	2,945	102	11

[1] Excluding running cost savings at t_0.

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9. Telephones

9.1. Introduction

9.1.1 Assistance concerning the probable impact of relocation on the cost of telephone facilities was provided by the G.P.O. (Shrewsbury Telephone Area), which encompasses the bulk of the Atcham R.D., and by the G.P.O. (West Midland Telephone Area), which serves a small part of Area D. The analysis is divided into two parts. First, we deal with existing subscribers, and secondly account is taken of the fact that the number of subscribers in the study area will probably grow over time.

9.2. Existing Subscribers

Depopulation: Savings

9.2.1 Should Areas B, C and D be depopulated, certain savings in the cost of providing services to existing consumers would be realised. These would consist of the cost of replacing existing installations at the end of their useful lives, as well as the cost annually incurred in maintaining such installations. The assets in question are underground and aerial cables, including individual subscribers' lines, and telegraph poles. (In certain circumstances depopulation could also allow the closure of an exchange, but this does not apply to our particular areas.)

9.2.2 Ideally, in assessing the present worth of the avoided replacement costs, we would have to know the remaining length of life of all assets currently existing in the area; we would then estimate the replacement cost that would be incurred in each of the 30 years subsequent to depopulation, and discount this stream of costs to arrive at a present value equivalent. Unfortunately, such information could not be obtained, but it is believed that a reasonable approximation to the savings accruing from depopulation may be made.

9.2.3 Information obtained from the G.P.O. showed that on average, in a rural district of this sort, the replacement cost of cables, lines and poles is about £60 per subscriber. In the absence of more detailed information, we have had to assume that in this respect the study area is typical of rural districts covered by the Shrewsbury Telephone Area, in terms of subscriber density and distance from the exchange. The telephone authorities agree that this is a reasonable assumption; we therefore took the cost of replacing the above mentioned assets in B, C and D at the present time as being £60 per subscriber.[1]

9.2.4 The economic life of the assets mentioned is, on average, roughly 20 years. Given our absence of knowledge concerning the time pattern of replacement, we have had to make a further assumption. This is that physical depreciation and replacement of assets takes place at a constant rate throughout the period

[1] Although the study area may be typical of other *rural* areas, it is not typical in terms of penetration rates for the *whole* Shrewsbury Telephone Area. See below, paragraph 9.3.2.

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we are considering, i.e. at £3 per annum per subscriber. Annual maintenance costs of such assets are listed by the G.P.O. at 2% of the installation cost, or £1·2 per subscriber. The number of existing subscribers in each area was established as follows: B, 67; C, 38; and D, 35. On this basis the annual savings achieved by depopulation were estimated as shown in Table 9.1.

TABLE 9.1

Annual Savings Resulting from Depopulation: Telephones (£)

Area	Replacement Cost Saving	Maintenance Cost Saving	Total Saving
B	201	80	281
C	114	46	160
D	105	42	147
B + C	315	126	441
B + D	306	122	428
C + D	219	88	307
B + C + D	420	168	588

9.2.5 Existing subscribers consist almost entirely of occupiers of domestic and farm properties, and the above figures allow for the retention of telephone kiosks in the depopulated areas. It is possible, however, that farm premises in the area, which would be retained for commercial, if not for residential purposes,[1] might also require the retention of telephones. Although a high proportion of properties in the area are currently used partly or entirely for agricultural purposes, we show below that the relocation solution would involve a drastic reduction in the number of farms. The consequence of this is that the possibility of retention of telephones in farmhouses is of negligible importance; we have not considered this further, the implicit assumption therefore being that, upon relocation, telephones will be provided at the residential rather than the commercial address of farmers.

9.2.6 A further point concerns the value in alternative uses of the equipment currently employed in Areas B, C and D. It could be, that upon depopulation, not only are replacement costs avoided, but some of the assets could be removed and used elsewhere. The value of such assets would be equal to the cost savings (mainly in the form of deferment of capital investment) made possible by their use outside the study area. Recovery of these assets would, however, involve a cost, as indeed would recovery of assets that have no value in alternative uses, but would have to be dismantled for reasons of safety should depopulation proceed.

$$\text{i.e.} \quad S = \sum_{t=o}^{n} \frac{R_t}{(1+r)^t} + V - R$$

[1] See Chapter 7.

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where S = present worth of savings due to depopulation,
R_t = annual (avoided) replacement cost,
V = value of recovered assets,[1] and
R = recovery cost.

9.2.7 It will be noted that our figures for savings do not allow for the recovery value of assets in the depopulated areas. The implication, therefore, is that V = R, or that the value of recovered assets is offset by recovery costs of equal magnitude. The G.P.O. have advised that this would be a reasonable assumption to make.[2]

9.2.8 Finally, it will be noted that, because overlaps between the areas are negligible, the saving resulting from depopulation of any combination of areas is equal to the sum of individual area savings.

Relocation: Costs

9.2.9 In estimating the cost of relocation on telephone services, we begin by assuming, since we wish to retain the same standard of service before and after relocation, that the number of subscribers remains the same. Relocation would therefore mean additional subscribers in the three relocation sites, as follows. (Subscribers in Area B are allocated on a pro rata basis.)

TABLE 9.2

Area Relocated	Site	Number of Subscribers	Nearest Exchange
B	Leebotwood	26	Leebotwood
	Longnor	20	Dorrington
	Acton Burnell	21	Acton Burnell
C	Leebotwood	38	Leebotwood
D	Acton Burnell	35	Acton Burnell

9.2.10 The cost of connecting these subscribers to the nearest telephone exchange was estimated as follows. First, we took the distance between the telephone exchange and the relocation site, and multiplied this by the G.P.O's factor of 1·25, which represents the average ratio of actual route mileage to radial distance. The cost of telegraph poles is £260 per mile, but we were able to ignore this because the relocation sites are in areas which are already populated, so telegraph poles already exist. The cost of installing aerial cables is estimated at £15 per mile per subscriber, and these require replacement after 18 years. In

1 $V = \sum_{t=o}^{n} \frac{k_t}{(1+r)^t} - \sum_{t=o}^{n} \frac{k'_t}{(1+r)^t}$

where k_t = cost of installing capital equipment *outside* the study area should depopulation not take place.
k'_t = cost of installing capital equipment outside the study area if depopulation does take place and recovered assets have uses elsewhere.

2 Similar assumptions were made in respect of electricity supply. (See paragraph 10.2.2.)

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contrast to the depopulation saving estimates, therefore, relocation capital costs can be expressed as lump sums. Annual maintenance of cables is estimated at 2·25% of the initial outlay.

9.2.11 The G.P.O. confirmed that the above would be the only relevant costs: there would be a negligible effect on the capacity of telephone exchanges to deal with additional subscribers. This is partly explained by the fact that some of the movement of population takes place within individual exchange areas. Relocation, therefore, involves the following costs:—

TABLE 9.3

Relocation Costs: Telephones (£)

Area Relocated	Initial Cost (t_0) (Repeated at t_{18})	Annual Maintenance
B	1,342	30
C	855	19
D	262	6
B + C	2,197	49
B + D	1,604	36
C + D	1,117	25
B + C + D	2,459	55

9.2.12 For Area B, the initial cost per property relocated is £20, for C it is £22 and for D, £7. The low cost per subscriber in D is explained by the close proximity of the Acton Burnell exchange to the relocation site. This is also relevant for some of the properties relocated from B, but to offset this, the Longnor site would be served by the Dorrington exchange, roughly two route miles away. Moreover (and this also applies to C), the Leebotwood exchange is about 1½ route miles from Leebotwood village.

TABLE 9.4

Summary: Existing Subscribers

Existing Telephone Subscribers: Net Costs (£)

Year	*Area Relocated*							
	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0	588	1,679	1,302	709	2,393	1,800	1,423	2,514
t_1–t_{17}	588	337	447	447	196	196	306	55
t_{18}	588	1,679	1,302	709	2,393	1,800	1,423	2,514
t_{19}–t_{30}	588	337	447	447	196	196	306	55

9.2.13 At t_0 and t_{18} relocation would require the construction of assets, the 18th year being when replacement is due. Thus, if none of the areas are relocated the cost is £588, this being the sum of annual costs incurred in the three areas in the absence of depopulation. If B is relocated we have the cost of constructing the assets for the relocation sites, £1,342, to which is added the annual maintenance cost, £30, plus the annual costs incurred in the areas remaining un-

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changed, i.e. £160 and £147. This gives us the total of £1,679. The annual costs for the remainder of the period are estimated in a similar manner.

9.3. Growth in the Number of Subscribers

9.3.1 So far we have only dealt with existing subscribers, but relocation might allow savings in the cost of connecting future subscribers. The saving would be the present worth of the cost of connecting occupiers of properties where they are now, less the present worth of so doing if they lived in one of the relocation sites.

9.3.2 To be precise, we would have to know the rate of growth in the number of subscribers should the existing settlement pattern be retained. This is rather a matter of conjecture, however, and we have in fact postulated a fairly arbitrary rate of increase, this being 3% per annum. This is less than the projected domestic penetration rate for the whole Shrewsbury area, but the latter figure would allow for new building taking place, and this possibility has been ignored in the present study.[1] Moreover, the proportion of properties with telephones in the study area is, at 53%, almost three times the domestic average for the whole Shrewsbury area. At a rate of 3% in fact, 100% penetration would be achieved in Area B in 22 years, in C in 13 years and in D in 26 years.

9.3.3 The next thing was to identify those properties currently without telephones in B, C and D. These were selected in random order, and the cost of connecting them (at a rate of growth of 3% per annum) to the nearest exchange estimated. In fact, we estimated the cost of connection to the nearest distribution point, these being identified by the authorities on a 2½″ map. It will be recalled that in estimating relocation costs, this was not done: then it was necessary to estimate the cost of installing cable for the whole distance between individual subscribers and the exchange. The reason for this was the presumption that the additional load of a new housing estate would be too heavy to rely on existing distribution points, even though, no doubt, a proportion of subscribers could be connected in this way. Cable costs were estimated as outlined above and, where applicable, the cost of telegraph poles was included; these have an installation cost of £260 per route mile, an economic life of 25 years and maintenance of 1% of initial cost per annum.

9.3.4 Installation costs were estimated for each year, up to the point that all properties in B, C and D were in receipt of telephone facilities. Maintenance costs were estimated and carried forward as a cumulative total. Replacement of assets after 18 or 25 years, as applicable, was also included.

9.3.5 Similar estimates were made for the same rate of growth in subscribers in the relocation sites although, as before, the cost of connecting individual subscribers direct to the exchange was estimated. This was a more straightforward task than estimating the cost of connecting the scattered properties in B, C and D, for we were able to assume that the initial cost per relocated property, and the associated maintenance cost, would remain constant for any one relocation site. A separate cost calculation for each property was therefore unnecessary.

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[1] See paragraphs 5.5.1 to 5.5.4.

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9.3.6 The annual total costs of telephone services in the study area are shown in Table 9.5. The costs of providing facilities to existing subscribers under the various assumptions are as indicated above; in the summary table these are combined with the costs that would be incurred as a result of a growth in the number of subscribers of 3% per annum.

TABLE 9.5

Annual Costs of Telephone Services: Summary Table (£)

Year	*Area Relocated*							
	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0	588	1,679	1,302	709	2,393	1,800	1,423	2,514
t_1	1,475	484	1,317	1,274	326	283	1,116	125
t_2	679	390	551	544	262	255	416	127
t_3	1,078	730	786	769	438	421	477	129
t_4	866	387	746	730	267	251	610	131
t_5	1,636	494	1,411	1,500	269	358	1,275	133
t_6	958	718	577	755	337	515	374	134
t_7	1,604	675	1,202	1,467	273	538	1,065	136
t_8	1,677	1,007	1,378	1,106	708	436	807	137
t_9	834	527	645	687	338	380	498	191
t_{10}	969	739	571	822	341	592	424	194
t_{11}	1,228	450	1,112	1,090	334	312	974	196
t_{12}	731	490	573	599	332	358	441	200
t_{13}	934	708	752	610	526	384	428	202
t_{14}	1,335	470	1,183	1,176	318	311	1,024	159
t_{15}	871	544	719	639	392	312	487	160
t_{16}	825	480	673	660	328	315	508	163
t_{17}	939	655	787	600	503	316	448	164
t_{18}	1,053	1,951	1,741	1,108	2,639	2,006	1,796	2,694
t_{19}	2,124	1,624	1,985	877	1,485	377	738	238
t_{20}	918	629	779	668	490	379	529	240
t_{21}	1,421	1,039	1,291	754	909	372	624	242
t_{22}	1,038	634	885	800	481	396	647	243
t_{23}	1,193	928	1,049	593	784	328	429	184
t_{24}	902	524	739	725	361	347	562	184
t_{25}	1,608	518	1,469	1,414	379	334	1,275	185
t_{26}	910	590	719	747	399	427	556	236
t_{27}	1,042	715	726	879	399	552	563	236
t_{28}	1,375	670	1,258	1,058	553	353	941	236
t_{29}	1,686	624	1,447	1,537	385	475	1,298	236
t_{30}	1,155	919	729	898	493	662	472	236

Present Worth Equivalent (£)

Discount Rate	None	B	C	D	B + C	B + D	C + D	B + C + D
6%	16,472	10,838	14,597	13,222	8,963	7,588	11,347	5,713
8%	13,552	8,999	12,096	10,993	7,543	6,440	9,537	4,984
10%	11,430	7,673	10,286	9,366	6,529	5,609	8,222	4,465
12%	9,845	6,694	8,943	8,145	5,792	4,994	7,243	4,092

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10. Electricity Supply

10.1. Introduction

10.1.1 The Shrewsbury District Office of the Midlands Electricity Board is responsible for electricity supply in the study area, and estimates of the effect of relocation were provided by that authority. In several respects the methods of estimation parallel those used for G.P.O. telephones, and this chapter follows a somewhat similar pattern to Chapter 9. First, the savings accruing from depopulation in respect of existing and new consumers are examined and then, separately, the cost is estimated of supplying electricity to *all* consumers should relocation take place.

10.2. Depopulation: Savings

Existing Consumers

10.2.1 Let us suppose that at t_0 all the assets currently existing in Areas B, C and D require replacement. If so, excluding 'backbone' lines that would be retained in the event of any or all of these areas becoming depopulated,[1] the cost of replacement would be as follows:—

TABLE 10.1
Electricity Supply
Cost of Replacing Assets at t_0 (£)

Area	Transformers	Overhead Lines	Services	Total
B	5,893	19,448	970	26,311
C	3,769	8,691	750	13,210
D	4,912	10,178	865	15,955

10.2.2 However, all assets will not require replacement at t_0; rather, replacement will take place at intervals over the 30-year period we are considering. As in the case of telephone services, we have had to assume, in the absence of more detailed information, that replacement takes place at an even rate throughout the period. The standard depreciation period for transformers and services is 25 years, and for overhead lines 30 years. On this basis the mean annual replacement cost saving, should depopulation take place, would be:—

TABLE 10.2
Electricity Supply: Annual Replacement Cost Saving (£)

Area Depopulated						
B	C	D	B + C	B + D	C + D	B + C + D
923	471	570	1,394	1,493	1,041	1,964

[1] Because of the existence of such lines there are no 'overlaps' of importance between existing areas B, C and D that are relevant to this study.

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The assumption made regarding the possible use of these assets elsewhere was the same as for telephone assets, i.e. that the value of recoverable assets would be roughly offset by the cost of recovery.[1]

10.2.3 It was not possible to distinguish between the annual running costs (maintenance, distribution losses, meter reading, administration, etc.) incurred in supplying people living in existing dwellings and those incurred should these people be relocated. The view of the electricity authorities was that this omission would not be too important, such costs being broadly the same for all consumers throughout the district, wherever they are situated. We will not have occasion, therefore, to refer to running costs again, as they would be recorded as being the same whether or not relocation takes place, at £6 per annum per consumer.

New Consumers

10.2.4 Relocation would involve the construction of new properties, all of which would, from t_0 onwards, be provided with electricity supply. To make pre- and post-relocation conditions comparable in cost terms, therefore, it was necessary to estimate the cost of making electricity supply available to those few properties in B, C and D which are as yet unconnected. Existing consumers, to which we referred in the previous sub-section, in fact include all but twelve dwellings in Area B, four in C and two in D.

10.2.5 The estimated cost of connecting new consumers to electricity supply is as follows:—

TABLE 10.3

Cost of Connection: New Electricity Consumers (£)

B	C	D	B + C	B + D	C + D	B + C + D
5,400	1,800	1,000	7,200	6,400	2,800	8,200

This expenditure would be required at t_0 and again at t_{25}, at which time replacement of services would become necessary.

10.3. Relocation Costs: All Consumers

10.3.1 Detailed schemes, corresponding to each relocation possibility, were drawn up by the electricity authorities and are summarised in the following tables:—

[1] See paragraph 9.2.7.

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TABLE 10.4

Cost of Supplying Electricity to Relocation Sites (£)

New Location	Sub-Station	High Voltage Cables	Medium Voltage Cables	High Voltage Lines	Services	Total
Area B						
Leebotwood ...	1,130	1,300	2,700	350	1,125	6,605
Longnor	1,130	1,300	1,600	350	850	5,230
Acton Burnell ...	1,130	1,300	1,500	350	900	5,180
TOTAL	3,390	3,900	5,800	1,050	2,875	17,015
Area C						
Leebotwood ...	1,130	1,300	2,700	350	1,260	6,740
Area D						
Acton Burnell ...	1,870	1,470	2,865	350	1,825	8,380
Areas B + C						
Leebotwood ...	1,870	1,470	3,150	350	2,385	9,225
Longnor	1,130	1,300	1,600	350	850	5,230
Acton Burnell ...	1,130	1,300	1,500	350	900	5,180
TOTAL	4,130	4,070	6,250	1,050	4,135	19,635
Areas B + D						
Leebotwood ...	1,130	1,300	2,700	350	1,125	6,605
Longnor	1,130	1,300	1,600	350	850	5,230
Acton Burnell ...	1,870	1,470	3,540	350	2,720	9,950
TOTAL	4,130	4,070	7,840	1,050	4,695	21,785
Areas C + D						
Leebotwood ...	1,130	1,300	2,700	350	1,260	6,740
Acton Burnell ...	1,870	1,470	2,865	350	1,825	8,380
TOTAL	3,000	2,770	5,565	700	3,085	15,120
Areas B + C + D						
Leebotwood ...	1,870	1,470	3,150	350	2,385	9,225
Longnor	1,130	1,300	1,600	350	850	5,230
Acton Burnell ...	1,870	1,470	3,540	350	2,720	9,950
TOTAL	4,870	4,240	8,290	1,050	5,955	24,405

10.3.2 The difference between the cost of supplying, *from scratch*, existing consumers plus new connections in Areas B, C and D, and that of supplying these consumers in the relocation sites, will be observed. Under the maximum relocation solution, the cost per property would be £92, compared with an average of £240 required to supply properties in existing locations. Of particular interest are the economies of scale to be derived from increasing the size of

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relocation sites. Thus, as the Acton Burnell and Leebotwood sites are expanded, the cost per property falls, as follows:—

TABLE 10.5

Acton Burnell		*Leebotwood*	
Number of Properties	Average Cost Per Property (£)	Number of Properties	Average Cost Per Property (£)
40	129	50	132
81	103	56	120
121	82	106	87

10.3.3 The cost of relocating B + D or B + C + D will therefore not simply be equal to the sum of the cost of relocating individual parts.

10.3.4 The expenditure listed above would be required at t_0; replacement would take place at t_{25} for sub-stations and services and at t_{30} for high voltage lines. The length of life of high and medium voltage cables is given as 40 years, so their replacement is not relevant for this study. The costs of supplying the relocation sites are therefore:—

TABLE 10.6

Cost of Serving Relocation Sites: Electricity Supply (£)

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0	17,015	6,740	8,380	19,635	21,785	15,120	24,405
t_{25}	6,265	2,390	3,695	8,265	8,825	6,085	10,825
t_{30}	1,050	350	350	1,050	1,050	700	1,050

10.4. Summary

TABLE 10.7

Annual Costs of Electricity Supply Installations

Summary Table (£)

Year	*Area Relocated*							
	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0	10,164	20,856	14,633	16,974	21,205	24,056	21,443	24,405
t_1–t_{24}	1,964	1,041	1,493	1,394	570	471	923	—
t_{25}	10,164	10,106	10,283	12,289	9,835	11,096	12,408	10,825
t_{26}–t_{29}	1,964	1,041	1,493	1,394	570	471	923	—
t_{30}	1,964	2,091	1,843	1,744	1,620	1,521	1,623	1,050

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TABLE 10.7—*continued*

Present Worth Equivalent (£)

Discount Rate	None	B	C	D	B+C	B+D	C+D	B+C+D
6%	39,109	37,480	37,293	38,762	31,393	33,199	36,946	27,110
8%	33,472	34,003	32,759	34,293	29,079	31,014	33,580	26,090
10%	29,435	31,566	29,539	31,141	27,494	29,537	31,245	25,464
12%	26,467	29,810	27,188	28,856	26,377	28,510	29,577	25,077

10.4.1 As an example of the way in which this table was calculated, the cost at t_0 where no relocation at all takes place (£10,164) comprises £8,200, the cost of all new connections in B, C and D, *plus* £1,964, the (undiscounted) annual-equivalent replacement cost for all of these areas. At t_{25}, the figure of £10,106 for Area B is comprised of £2,800, the cost of replacing 'new' consumers' connections in C + D, which will continue to be inhabited, *plus* £1,041, the annual-equivalent replacement cost for C + D, *plus* £6,265, the cost of replacing certain assets in the relocation sites applicable to B.

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11. G.P.O. Mail

11.1. Introduction

11.1.1 The whole of the study area comes within the region served by the Head Post Office, Shrewsbury, officials of which assisted in the estimation of the effects of relocation on the cost of providing mail services. Relocation would, in fact, permit savings to be achieved in vehicle mileage, staff time and sundry expenditures in respect of the provision of mail collection and delivery. These are now examined in turn.

11.2. Mileage Costs

11.2.1 The costs of operating Post Office vehicles for the collection and delivery of mail for the areas concerned are estimated at the official Post Office rate of 5·4 pence per mile, estimates of the effect of relocation being given in Table 11.1.

TABLE 11.1

Annual Vehicle Mileage Costs: G.P.O. Mail (£)

Area Relocated							
None	B	C	D	B + C	B + D	C + D	B+C+D
376	275	376	295	275	194	295	194

11.2.2 It will be observed that the maximum annual saving achieved by relocation on this account is only £182 (i.e. where B + D or B + C + D are relocated). No vehicle mileage savings result from the relocation of C, since all journeys within this area are by postmen on foot or bicycle and delivery of mail to the area as a whole is by means of a vehicle that would have to travel along the same route even if C were depopulated (i.e. along the A49 from Shrewsbury to Church Stretton).

11.2.3 It can also be seen that the sum of individual savings per area relocated equals the aggregate saving should any combination of those areas be relocated. This is because, with one exception, which is of negligible importance, the routes currently taken by postal vehicles do not overlap our areas designated B, C and D, although routes passing through any one of these areas must also pass through districts outside the study area or through Area A. In the latter type of case, one has to estimate the route that postal vehicles would take if the area(s) concerned were to be depopulated. Sometimes this would mean that the vehicle would stop at the boundary of the area: sometimes it would require that the shortest route through the area be taken, if the postal vehicle has to serve districts either side of it. It may be, as shown in the case of C, that the existing route is already the shortest route between two other localities, so that the existing mileage cost is zero.

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11.3. Staff Costs

11.3.1 Staff costs involved for the various relocation possibilities are shown in Table 11.2. In estimating these, official Post Office figures were again used, but these were adjusted in order to isolate, as far as possible, the real cost of employing labour. For example, the cost per full-time postman, working a 39–43-hour week, is reckoned at £1,015 per annum by the Post Office, this figure being inclusive of an allowance for leave, pension, uniform and national insurance. However, an estimate was made of the national insurance component (employer's contribution), which was deducted from the total, as being only a transfer payment. In addition to this basic cost, a sum was included for Sunday duty.

TABLE 11.2
Annual Staff Costs: G.P.O. Mail (£)

Area Relocated							
None	B	C	D	B + C	B + D	C + D	B+C+D
10,113	8,208	9,211	9,025	7,313	6,841	7,931	6,171

11.3.2 The estimate of the effect of relocation on staff costs was made in a fairly detailed manner. Thus, where relocation would mean that there would be insufficient work to warrant the employment of a full-time postman, the assumption was made that an auxiliary postman (18–38 hours weekly) would be employed instead and the difference in the rate of pay allowed for. Similarly, should the employment of an auxiliary postman not be warranted, the employment of an 'allowance deliverer' (up to 18 hours weekly) was on occasion assumed. The cost of providing mail services for relocated properties was estimated on the basis of the costs normally incurred by the Post Office in delivering mail to housing estates.

11.3.3 The savings on this account are much more significant than the vehicle mileage savings, the bulk of them being due to the reduction in time taken by postmen in travelling by bicycle or on foot from one property to another, and the consequent reduction in numbers employed. For example, the annual saving on staff of £3,942 should B + C + D be relocated (i.e. £10,113 − £6,171) is equivalent to £14·9 per relocated property, out of a total saving per property of £15·7. The numbers of postmen required under the various assumptions are, in fact, estimated as follows:—

TABLE 11.3
Staff Requirements: G.P.O. Mail

Area Relocated	Full-time Postmen	Auxiliary Postmen	Allowance Deliverers
None	8½	4	1
B	6½	3	1
C	7½	4	1
D	7½	4	—
B + C	5½	3	2
B + D	5	5	—
C + D	6	5	—
B + C + D	4	4	1

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11.3.4 This table does not tell the whole story, however, for relocation would sometimes involve not only changes in the number of postmen employed, but also variations in the hours worked by the auxiliary postmen and allowance deliverers. Because of this possibility, and of the existence of various grades of labour, the system is fairly flexible. Despite this, however, there remains some 'lumpiness' in the employment structure, evidence for this being that upon relocation of Area C or Area B alone, no extra staff would be required for Leebotwood deliveries; existing staff could absorb the additional work at no extra cost. On the other hand, should B + C (or B + C + D) be relocated together, the additional load could not be absorbed by existing staff in the Leebotwood district. Extra costs would therefore be incurred; this could explain the fact that, compared with B and C individually, the saving per property if B + C or B + C + D are relocated is smaller than might have been expected.

11.4. Sundry Costs

11.4.1 These consist of bicycle maintenance, depreciation and cleaning, and are as follows:—

TABLE 11.4

Annual Sundry Costs: G.P.O. Mail (£)

Area Relocated							
None	B	C	D	B + C	B + D	C + D	B+C+D
105	89	89	105	74	89	89	74

11.5. Summary

11.5.1 Table 11.5 now summarises the data listed in Tables 11.1, 11.2 and 11.4.

TABLE 11.5

Total Annual Costs: G.P.O. Mail (£)

Year	*Area Relocated*							
	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0–t_{30}	10,594	8,572	9,676	9,425	7,662	7,124	8,315	6,439

Present Worth Equivalent (£)

Discount Rate	None	B	C	D	B + C	B + D	C + D	B + C + D
6%	156,419	126,564	142,865	139,159	113,128	105,185	122,770	95,071
8%	129,859	105,074	118,606	115,530	93,919	87,324	101,923	78,928
10%	110,463	89,380	100,891	98,274	79,891	74,281	86,700	67,139
12%	95,931	77,621	87,618	85,345	69,381	64,509	75,294	58,306

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11.5.2 Annual total savings and savings per property achieved by relocation are therefore as shown in Tables 11.6 and 11.7.

TABLE 11.6
Total Annual Savings: G.P.O. Mail (£)

Year	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0–t_{30}	—	2,022	918	1,169	2,932	3,470	2,279	4,155

TABLE 11.7
Annual Savings per Relocated Household: G.P.O. Mail (£)

Year	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0–t_{30}	—	15·8	16·4	14·4	15·9	16·6	16·6	15·7

11.6. General Comments

11.6.1 No allowance has been made for possible redeployment of staff, changes in postal routes, etc., that might take place *outside* the study area as a result of relocation. Tables 11.6 and 11.7 therefore present minimum estimates only of potential savings.

11.6.2 There may be circumstances in which relocation would require the construction of additional Post Offices or enlargement of existing ones to deal with the needs of the concentrated areas. The postal authorities in this case, however, say that the number of households involved is not large enough to warrant such action: the sub-Post Offices already existing in Area A would be adequate.

11.6.3 We have partially succeeded in retaining the same standard of postal service subsequent to relocation, in that the frequency of deliveries is assumed to remain unchanged. On the other hand, relocation would almost certainly improve the standard, since deliveries would be made earlier in the day and collections could be made later. This would provide a net benefit to relocated householders, but no attempt has been made to quantify it.

11.6.4 We have shown the annual costs and savings resulting from relocation, given the postal arrangements currently in operation. It has had to be assumed, in the absence of evidence to the contrary, that similar arrangements would continue to exist in following years and therefore that the annual cost figures would remain constant between t_0 and t_{30}.

11.6.5 Total costs in Tables 11.1, 11.2, 11.4 and 11.5 in each case include the cost of providing postal services in A. In fact, the Area A actually used by the postal authorities is not identical to that shown on Map 2. This does not make much difference, as long as the sites chosen for relocation are included, since the costs of serving A are to be found on both sides of the calculation. On the other hand, we are unable to estimate the average cost of postal services per property in any combination of areas that includes A.

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12. Schools

12.1. Introduction

12.1.1 The effect of relocation on educational facilities in the study area was also examined, the presumption being that relocation would involve the closure of some schools, while others would have to be extended or new ones built. Estimates were made of the additional building costs entailed, as well as of savings in annual running costs.

12.2. Existing Educational Arrangements

Area B

12.2.1 The majority of children of primary school age in this area attend either Cardington C. of E. or Church Preen County School, these being the only schools within any of our potential depopulation areas. Older children travel to Church Stretton Modern, Abraham Darby Comprehensive, Much Wenlock Modern, the Priory Schools, Wakeman School and Shrewsbury Technical College.

Area C

12.2.2 Primary school children usually attend Longnor C. of E. School. Older children normally travel to the Church Stretton or Shrewsbury schools listed under Area B.

Area D

12.2.3 Children in this area mainly attend Church Preen County Primary School, although some travel to Acton Burnell. With the exception of the Church Stretton schools, older children also attend the schools listed under Area B.

12.3. Schools Affected by Relocation

Acton Burnell C. of E. (Primary)

12.3.1 This school, which lies within Area A, is scheduled for demolition, and a new one is planned to be built in its place. Relocation of Areas B and D, and the extension of Acton Burnell village, would clearly mean that more children would come within this school's catchment area. Estimates were made of the costs of accommodating the various numbers of children different relocation assumptions require.

Cardington C. of E.

12.3.2 The future of Cardington village school is somewhat uncertain: even in the absence of depopulation of the surrounding area there is the possibility of its closure, since it is considered to be too small to be efficient. Relocation of the population currently in Area B would certainly mean that it would be closed, and it is assumed in the following estimates that closure is dependent solely upon this eventuality. Should this happen, children remaining in Cardington

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village (i.e. those living in properties currently in receipt of W.S.W.B. supplies) would have to travel to Rushbury C. of E. School, about two miles to the south.

Church Preen County

12.3.3 This school takes children from both Area B and Area D. Relocation of B would mean its closure; relocation of D would not have this effect, but the annual running costs of the school would be considerably reduced.

Longnor C. of E.

12.3.4 Relocation of Area B would mean that additional children would attend Longnor School, and this would require extensions to be made, and additional running costs would be incurred. Relocation of people now living in C would not affect the costs of this school, because most children of primary school age in Area C already attend it, and would continue to do so if relocated in Leebotwood.

Rushbury C. of E.

12.3.5 As already stated, Rushbury C. of E. School would absorb some of the children currently attending Cardington School should B be depopulated. This could be done without the need for construction of additional accommodation, but additional running costs would be incurred.

Other Schools

12.3.6 Apart from primary schools, no educational establishments exist in Areas B, C or D, and children over primary school age normally travel outside the study area to the schools listed under Area B above.[1] In relation to the number and size of these schools, the number of children is insignificant, and it is believed that the impact of relocation on schools outside the study area would be negligible. This attitude is reinforced by our stipulation that people should be moved as short a distance as possible from existing locations. Consequently, schools that are currently most convenient for children to attend will normally remain so even after relocation. On the other hand, the cost of travel to schools outside the area will be affected; this is estimated in a separate section dealing with the costs of educational transport.[2]

12.4. Capital Costs

No Relocation

12.4.1 Even without relocation, Acton Burnell School is to be rebuilt. The cost of this, including the purchase of the new site, the building itself, furniture and equipment, would be £25,000. We assume, in compiling our summary table,[3] that this expenditure would be incurred at t_0. (This also applies to other capital costs incurred under the various relocation assumptions.)

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[1] See paragraph 12.2.1.
[2] See paragraph 14.5.
[3] See paragraph 12.6 (Table 12.5).

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B Relocated

12.4.2 The education authority (Shropshire County Council) states that an additional 38 houses in Longnor and 50 in Leebotwood would necessitate an extension to Longnor School, which would then have to be able to accommodate a total of 120 children (i.e. a four-class school). Should B be depopulated, Cardington and Church Preen schools would close; Cardington village children would be transferred to Rushbury School, to which no extension would be necessary. Other children in the area would then attend Acton Burnell School. Should this be the end of the matter, the additional 40 houses in Acton Burnell would require a three-class school to be built, capable of accommodating 80 children. The capital costs of meeting these requirements would be as follows:—

TABLE 12.1

	Acton Burnell (£)	Longnor (£)
Building	27,810	19,700
Site	1,500	—
Equipment, etc.	3,500	2,400
TOTAL	£32,810	£22,100

12.4.3 However, closure of Church Preen School would mean that children from Area D currently attending it would have to travel elsewhere to school. It is conceivable that they could be absorbed into several primary schools on the fringe of the area with no additional capital cost. If so, the above total of £54,910 would be correct. This, however, is unlikely, and a more realistic alternative would be to assume that children from this area would attend Acton Burnell School. To all intents and purposes, therefore, as far as actual school costs are concerned, the relocation of Area B would be identical to relocation of B + D.

12.4.4 On this basis, Acton Burnell School would increase its catchment area by 121 dwellings and would then require four classes, capable of accommodating a total of 100 pupils. The capital cost of meeting this target would be:—

TABLE 12.2

	(£)
Building	32,445
Site	1,500
Equipment, etc.	4,055
TOTAL	£38,000

12.4.5 Longnor School costs would of course be unaffected, so the total capital cost incurred upon relocation of B would now be £60,100.

C Relocated

12.4.6 No additional cost would be incurred, for the reasons already mentioned.

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D Relocated

12.4.7 The construction of an additional 81 houses in Acton Burnell village would require the village school to be enlarged, but by a lesser extent than if Area B were relocated. It is estimated that a 90-place, three-class school would be needed. The cost of this would be as follows:—

TABLE 12.3

	(£)
Building	30,130
Site	1,500
Equipment, etc.	3,770
TOTAL	£35,400

12.4.8 We have noted that relocation of D would not entail the abandonment of Church Preen School, although the number of pupils in attendance would be considerably reduced.

B + C Relocated

12.4.9 Since relocation of people living in Area C would not affect school costs, the capital cost is as for B above, i.e. £60,100.

B + D Relocated As for B.
C + D Relocated As for D.
B + C + D Relocated As for B.

12.5. Annual Running Costs

12.5.1 As an offset to the capital costs that would be incurred, the closure of small village schools and rationalisation into larger units can, in general, be expected to yield savings in running costs, the most important element of which will normally be savings in teachers' salaries. The creation of larger schools is also likely to allow economies of scale and savings in the cost of auxiliary staff (groundsmen, secretaries, caretakers, cleaners and canteen staff), equipment, heating and repair and maintenance of buildings. In our particular area, the estimated effects are as follows:—

TABLE 12.4

Annual Running Costs: Schools (£)

	Area Relocated							
	None	B	C	D	B + C	B + D	C + D	B + C + D
Acton Burnell	4,520	8,000	4,520	7,700	8,000	8,000	7,700	8,000
Cardington	4,030	—	4,030	4,030	—	—	4,030	—
Church Preen	7,560	—	7,560	3,500	—	—	3,500	—
Longnor	7,490	8,300	7,490	7,490	8,300	8,300	7,490	8,300
Rushbury[1]	—	1,480	—	—	1,480	1,480	—	1,480
TOTAL	23,600	17,780	23,600	22,720	17,780	17,780	22,720	17,780

[1] Additional cost of Cardington village children only.

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12.5.2 The explanation of the relative cost of running particular schools subsequent to relocation is to be found, implicitly, in the discussion of school capital costs.

12.6. Summary

TABLE 12.5

Net Costs of Relocation: Schools (£)

	Area Relocated							
Year	None	B	C	D	B + C	B + D	C + D	B + C + D
t_0	48,600	77,880	48,600	58,120	77,880	77,880	58,120	77,880
t_1–t_{30}	23,600	17,780	23,600	22,720	17,780	17,780	22,720	17,780

Present Worth Equivalent (£)

Discount Rate	None	B	C	D	B + C	B + D	C + D	B + C + D
6%	373,450	322,619	373,450	370,857	322,619	322,619	370,857	322,619
8%	314,284	278,043	314,284	313,897	278,043	278,043	313,897	278,043
10%	271,075	245,491	271,075	272,299	245,491	245,491	272,299	245,491
12%	238,702	221,101	238,702	241,134	221,101	221,101	241,134	221,101

12.6.1 At t_0 capital and running costs are included, while from t_1 to t_{30} the figures refer solely to running costs.

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13. Travel to Work, Shops, Entertainment and Market

13.1. Introduction

13.1.1 We now present estimates of the repercussions of relocation on the cost of conveying individuals to work, shops and places of entertainment. It is also convenient under this heading to examine journeys made by farmers in the course of their business, these being typified by journeys to market.[1] Since no journeys of this nature relevant to the study are made by rail, this chapter deals only with travel by means of private car and bus.

13.1.2 The investigation required a comprehensive study of the travel patterns of individual households to be made, the general plan being to estimate the annual mileage and associated travel costs given the existing settlement pattern, and to compare this with the mileage and costs that would be incurred in making such journeys should relocation take place. In addition to the estimation of vehicle operating costs, we were also concerned with the value of time spent in travelling.

13.1.3 Information was obtained from two main sources. First, a travel survey was carried out, the details of which are shown in Appendix II. (Information listed in (f) to (l) of the survey form was obtained for other purposes.[2]) Every property in B, C and D was visited, and householders were asked to supply data on travel habits. In addition, certain properties in Area A were visited, and the same information sought. Here we were particularly concerned with occupiers of properties in Acton Burnell, Leebotwood and Longnor; as these were the potential relocation sites, it was important to obtain information concerning journeys (particularly for shopping and entertainment purposes) made by current residents, as being a probable indication of journeys of a similar nature that would be undertaken by newcomers to these villages. Information was also provided by the major bus operator in the area, the Birmingham and Midland Motor Omnibus Company ('The Midland Red').

13.2. Private Cars: Operating Costs

Estimation of Costs

13.2.1 As will be seen from the questionnaire, details of the journeys undertaken by the various members of each household were obtained. These included data on destinations, frequency of journeys, mode of travel and, if a journey was undertaken by private car, the type of car used and whether or not it was driven by the individual concerned. (The latter permitted avoidance of double or multiple-counting if more than one person travelled in the same car.)

13.2.2 On receipt of this information it was a fairly straightforward matter to estimate the annual mileage covered in private cars by people currently residing

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[1] The transport of children to school and other transport implications are treated separately.
[2] See paragraphs 17.3.3 and 17.3.4.

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in Areas B, C and D. It was then necessary to translate this into money terms, for comparison to be made with the cost of journeys undertaken *by the same means of transport* under the various relocation solutions.

13.2.3 It is necessary to emphasise that the calculation of travel costs under the new location pattern should be based upon the assumption that journeys of a given nature will continue to be made by the same mode of transport as was used prior to relocation. The reason for this is that although as a general rule concentration of population can be expected to encourage the substitution of travel by bus for travel by private car,[1] to take this into account in the present exercise would be to depart from the requirement that the standard of facilities in the area remains as far as possible the same after relocation as it was before.

13.2.4 For example, prior to relocation, it may be inconvenient for people living in a sparsely populated area to travel to the nearest bus route, whereas after relocation they are likely to find themselves in close proximity to a bus stop. In these circumstances, if there is spare capacity, the substitution of travel by bus for travel by car would create no additional social cost in operating buses, but there would be a saving in the costs hitherto incurred in travelling by car. Comparison of the costs of the 'before' and 'after' situation in this way is not, however, given the nature of the present study, valid; substitution of one means of transport for another involves, by definition, a *qualitative* change. The only way such effects can be isolated is by comparing, for example, the cost of travelling from a point somewhere in Area C (i.e. prior to relocation) to Shrewsbury by private car with the cost of travelling from the relocation site (in this case Leebotwood) to Shrewsbury in an identical vehicle.

13.2.5 The requirements of equal standards of amenity simplifies the estimation of the effects of relocation, but problems do arise when relocation would require that journeys be carried out where none were made before. Here there is no escape from some estimate of the extent to which public, rather than private, transport is used. This is dealt with below.[2]

13.2.6 We now turn to the calculation of costs per vehicle-mile. In the present study it is necessary to isolate those costs that are a function of miles travelled and to exclude any costs that might be incurred if a car is left standing in a garage (e.g. physical depreciation that is a function purely of time). Moreover, as we are only concerned with the *real* costs of travel, in terms of the resources that have to be given up to make that travel possible, costs that merely represent transfer payments from one section of the community to another must be excluded, even if such payments *are* a function of miles travelled. In this bracket are included taxes of various sorts, the most important being those on petrol and oil. Likewise, the purchase tax element of those depreciation costs which vary with mileage should be ignored.[3]

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[1] Substitution could of course, in some cases, work in the opposite direction.

[2] See paragraphs 13.2.18 to 13.2.20.

[3] Transfer payments that do *not* vary with mileage are therefore excluded on two counts. Two good examples are the remaining purchase tax element of depreciation costs and the cost of a road fund licence.

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13.2.7 Formulae for estimating vehicle costs per mile are provided by the Road Research Laboratory in *Research on Road Traffic*.[1] In addition to actual vehicle operating costs, all the figures quoted include an allowance for the value of the working time of vehicle occupants, certain standard occupancy rates and relative proportions of business and leisure time being assumed. The cost of working time per mile clearly varies with the speed of the vehicle concerned. Moreover, the R.R.L. show that, for private cars, an element of vehicle operating costs also varies, up to 40 m.p.h., with speed. Beyond this point, the only costs varying significantly with speed relate to the time spent in travelling by the occupants of vehicles. The R.R.L. therefore provide two sets of formulae, corresponding to the two ranges of speed. In addition, for private cars and public service vehicles, two sub-divisions are made, (a) where non-working time is valued at zero, and (b) where non-working time is valued at three-quarters the value of working time.[2] Non-working time, it should be noted, is defined to include time spent travelling to and from work.

13.2.8 For our purposes, the information thus provided was inadequate in several ways. First, the published figures related to 1963 costs and were therefore somewhat out of date. Secondly, we had data on vehicles in the area which permitted a breakdown into several size categories, yet the cost per mile of a private car of only one size (a 'typical' vehicle of 1,750 c.c.) was quoted by the R.R.L. Finally, we were able to obtain fairly accurate information concerning the nature of individual journeys within the study area; we therefore had data of our own on occupancy rates, object of journeys (i.e. business or leisure) and the nature of employment of car occupants. In some cases, therefore, rather than using the R.R.L's average figures for the value of working time, it was possible to obtain more precise estimates of costs per mile by using the R.R.L's estimates of vehicle operating costs (i.e. excluding all time costs) and our own locally collected information concerning working and non-working time. The R.R.L. estimates[3] of vehicle operating costs are as shown in Table 13.1.

TABLE 13.1

Cost per Vehicle-Mile (1966 prices)

Cars: Marginal Operating Costs only

(i.e. excluding any allowance for time costs)

Cubic Capacity	(pence per mile) Speed (S) < 40 m.p.h.	Speed (S) $\geqslant 40$ m.p.h.
$\leqslant$1,000	$2{\cdot}6 + \frac{19}{S}$	$3{\cdot}1 + \frac{3}{S}$
1,501—2,000	$3{\cdot}9 + \frac{30}{S}$	$4{\cdot}6 + \frac{4}{S}$
2,001—2,500	$5{\cdot}0 + \frac{34}{S}$	$5{\cdot}7 + \frac{6}{S}$

1 *Research on Road Traffic*, Road Research Laboratory, 1965, Ch. 15.
2 This procedure has since been changed. (See paragraph 13.4.5 (footnote 1 refers).)
3 The R.R.L. provided other information as well. (See paragraphs 13.3.6 and 14.6.2.)

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13.2.9 In view of the above it was necessary to make estimates of the speed of traffic in the study area, as well of speeds on certain roads *outside* the study area, should their use be affected by relocation. Here a distinction was made between classified and unclassified roads. The classified roads concerned are the A49, which runs along the western boundary of the study area, and the A458, which travels in a south-easterly direction from Shrewsbury to Much Wenlock. Although outside the study area, being some distance to the east, the latter road is relevant in that relocation would mean that some vehicles would transfer to this road rather than use, as they currently do, certain unclassified roads.

13.2.10 Having made this distinction, the assumption was that the average speed of private cars on the relevant portions of the classified roads was 40 m.p.h., while all the unclassified roads were placed in one category, and an average speed of 30 m.p.h. on these roads assumed. On this basis the operating cost per vehicle mile of cars of various sizes is as shown in Table 13.2. It will be noted that on a given type of road the same average speed was assumed for all vehicles, irrespective of size.

TABLE 13.2

Operating Costs Per Vehicle Mile (pence)

Vehicle Size Group	Cubic Capacity	Classified Roads	Unclassified Roads
(1)	$\leqslant$ 1,000	3·1	3·2
(2)	1,001–1,500[1]	3·9	4·0
(3)	1,501–2,000	4·7	4·9
(4)	2,001–2,500	5·8	6·1

Results of the Survey

13.2.11 Although every property in each of Areas B, C and D was visited, only 162 out of a possible 265 households supplied information (i.e. 61%). The main reason for this was simply that people often were not at home when called upon, although several properties were unoccupied at the time. (Only two householders refused to answer the questions put to them.)

13.2.12 There is therefore probably some bias in the results, in that not enough weight is given to the travel patterns of those households in which no one is at home during the day time, when most of the survey work was done. All properties which were empty when first called upon were revisited and, in order to go some way towards the avoidance of bias, as many recalls as possible were made at weekends and during the evenings.

13.2.13 Current mileage and other data for each of the three areas were estimated by extrapolation of the results of the sample. We now examine each area in turn.

[1] Formulae for the 1,001–1,500 c.c. group were not provided by the R.R.L. We merely took the mean of the figures for the $\leqslant$ 1,000 and 1,501–2,000 c.c. classes.

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Area B

13.2.14 In this area 79% of households owned at least one car, and there were, on average, 1·01 cars per household. The breakdown into vehicle size groups, as defined in Table 13.2, was as follows:—

(1) 39·7%
(2) 38·2%
(3) 16·2%
(4) 5·9%

Existing Types of Journey

13.2.15 We consider first the effect of relocation on the mileage covered in completing journeys of an equivalent nature to those currently undertaken; i.e. existing journeys to work, shops, entertainment and market.[1] This is shown in Table 13.3.

TABLE 13.3

Effect of Relocation on Annual Mileage: Existing Journeys by Private Car: Area B

Relocation Site	Classified Roads	Unclassified Roads	Total
Acton Burnell	− 21,964	− 11,093	− 33,057
Leebotwood	− 7,072	− 18,136	− 25,208
Longnor	− 8,889	+ 9,060	+ 171
TOTAL	− 37,925	− 20,169	− 58,094

13.2.16 Relocation would therefore shorten such journeys by 58,094 miles per annum, divided between classified and unclassified roads in the proportions shown. In general, this is explained by the fact that people are moved closer to Shrewsbury than they were before.

13.2.17 For most people, the final destination of such journeys was assumed to remain unchanged. This is justified mainly by the requirement that relocation should not be at such a distance as to make it unreasonable for people to continue to work where they do at present. Moreover, examination of journeys to shops and entertainment by people currently residing in Acton Burnell, Leebotwood and Longnor also showed great similarity to journeys of a like nature undertaken by people now living in Areas B, C and D. This, too, is explained by the shortness of the distance between existing settlements and the appropriate relocation sites, and is reinforced by the fact that Shrewsbury is an outstanding focal point for the whole area. Farmers' business journeys are another matter however: there appears to be a stronger pull exerted by other towns in the region in this respect, but since the farms themselves are not to be moved, it was assumed that these destinations, too, would remain unchanged.

[1] See Appendix III for a discussion of journeys made by farmers for business purposes.

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Other Journeys

13.2.18 Table 13.3 only includes the effect on existing types of journey, but over and above these, certain journeys would, upon relocation, be required that were not made at all before, while relocation would make others unnecessary.

13.2.19 First, relocation would make additional journeys necessary, in that farmers would now have to travel from their homes in the relocation sites to their place of work (i.e. back to the farms they have vacated). It has been noted,[1] however, that not all farmworkers would continue to be so employed: in Area B only 35 out of the 84 people currently working on farms would be retained, so daily journeys from relocation sites to farms would be restricted to this number of people. In our estimates, all such journeys were presumed to be undertaken by private car: the scattered location of farm properties would rule out the use of public transport, and the high proportion of car owners in the area would make this a reasonable hypothesis. Indeed, car ownership would probably be an essential condition of employment in such circumstances. As a final point, all 'return' journeys to farms in the study area would be on unclassified roads.

13.2.20 It has been stipulated that it should be reasonable to expect people to remain at the same place of work after relocation, but this clearly cannot apply to farm workers made redundant by the change; i.e. the remaining 49 workers. These people, too, would now have to make journeys where none (or a negligible proportion) were made before, for they would now have to travel some distance to work. The new place of employment and mode of transport used by redundant farmworkers are a matter of conjecture, but in view of the importance of Shrewsbury in the area, it has been assumed that all would have to travel to that town[2] to obtain alternative employment. The arbitrary assumption was also made that 50% of such journeys would involve private car costs, the remaining 50% being divided equally between bus or car passenger journeys.

13.2.21 It will be recalled that the agricultural calculations were based upon two alternative hypotheses, (a) that the absorption of the additional labour force made available in the area would take two years, and (b) that immediate re-employment would be obtained. Under (a) the mileage annually covered in journeys to new places of employment would increase over the two-year period, after which it would remain constant, while under (b) the total increase would take effect at t_0 and remain constant thereafter. Two sets of results, based upon the alternative assumptions regarding the re-employment time lag, are therefore presented in this section.

13.2.22 As an offset to this increase, some journeys made before relocation would not be made subsequently. This again applies to redundant farmers, who would no longer have to make journeys to market, agricultural suppliers, etc. For the reason set out below, these savings need not be included in the present estimates, as long as the journeys concerned were, prior to relocation, made solely for business purposes and not also for shopping or other reasons.[3]

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[1] e.g. see paragraph 7.3.25.

[2] Or an equivalent distance, by the same means of transport as that postulated for the journey to Shrewsbury.

[3] See Appendix III.

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Summary: Area B

13.2.23 Aggregating the effects of relocation on existing types of journey and adjusting to take account of the repercussions on the farming community, the results shown in Table 13.4 are obtained. For convenience, the estimates are presented—as indeed they are in most of the tables in this section—as if the hypothesis of a two-year re-employment lag applied. In each case the data given for $t_2 - t_{30}$ would simply apply to $t_0 - t_{30}$ under the alternative assumption of a zero re-employment time lag.

13.2.24 It will be noted that the savings on existing types of journey are more than offset by the additional mileage farmers would have to cover. The annual mileage for existing types of journey and those made by farmers back to their farms is taken as being constant; the only variation is in journeys to work, which may increase over the first two years. No allowance is made for any increase over time in the rate of car ownership per household.

TABLE 13.4

Effect of Relocation on Aggregate Annual Mileage (Private Cars): Area B

Year	Relocation Site	Classified Roads	Unclassified Roads	Total
t_0	Acton Burnell	− 21,964	+ 23,465	
	Leebotwood	+ 13,130	+ 5,945	
	Longnor	+ 471	+ 25,232	
	TOTAL	− 8,363	+ 54,642	+ 46,279
t_1	Acton Burnell	− 21,964	+ 33,865	
	Leebotwood	+ 30,446	+ 5,945	
	Longnor	+ 9,831	+ 26,532	
	TOTAL	+ 18,313	+ 66,342	+ 84,655
t_2–t_{30}	Acton Burnell	− 21,964	+ 44,265	
	Leebotwood	+ 47,762	+ 5,945	
	Longnor	+ 19,191	+ 27,832	
	TOTAL	+ 44,989	+ 78,042	+ 123,031

13.2.25 Finally, the above mileage is converted into money terms: all journeys are allocated among vehicle size groups in accordance with the proportions listed in paragraph 13.2.14. The results are as follows:—

TABLE 13.5

Effect of Relocation on Annual Operating Costs of Private Cars: Classified Roads: Area B (£)

Year	*Vehicle Size Group*				Total
	(1)	(2)	(3)	(4)	
t_0	− 43	− 52	− 26	− 12	− 133
t_1	+ 94	+ 114	+ 58	+ 26	+ 292
t_2–t_{30}	+ 231	+ 280	+ 143	+ 64	+ 718

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TABLE 13.5—*continued*

Unclassified Roads

t_0	+ 289	+ 348	+ 181	+ 82	+ 900
t_1	+ 351	+ 423	+ 219	+ 99	+ 1,092
t_2–t_{30}	+ 413	+ 497	+ 258	+ 117	+ 1,285

13.2.26 The annual net cost of relocation in Area B is therefore estimated as follows:—

TABLE 13.6

Annual Net Cost of Relocation: Area B

Two year Re-employment Lag		Zero Re-employment Lag	
	£		£
t_0	767	t_0–t_{30}	2,003
t_1	1,384		
t_2–t_{30}	2,003		

13.2.27 As similar calculations were made for C and D, the results for these two areas can be described more briefly.

Area C

13.2.28 Proportion of households with at least one car: 68%
Average number of cars per household: 0·81
Breakdown into size groups:

(1) 45·5%
(2) 45·5%
(3) —
(4) 9·0%

Existing Types of Journey

TABLE 13.7

Effect of Relocation on Annual Mileage: Existing Journeys by Private Car: Area C

Relocation Site	Classified Roads	Unclassified Roads	Total
Leebotwood	+ 34,405	− 36,456	− 2,051

13.2.29 A slight saving in mileage would therefore be possible on existing types of journey, the A49 route largely being substituted (for journeys to Shrewsbury and Church Stretton) for the unclassified roads hitherto used.

Other Journeys

13.2.30 Six out of fifteen full-time farm workers would be made redundant by relocation. The same assumptions are made regarding the proportion of journeys

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to work involving private car costs, destinations and time unemployed as for Area B.

TABLE 13.8

Effect of Relocation on Aggregate Annual Mileage (Private Cars): Area C

Year	Classified Roads	Unclassified Roads	Total
t_0	+ 40,177	− 29,270	+ 10,907
t_1	+ 45,949	− 29,270	+ 16,679
t_2–t_{30}	+ 51,721	− 29,270	+ 22,451

Summary: Area C

TABLE 13.9

Effect of Relocation on Annual Operating Costs of Private Cars: Classified Roads: Area C (£)

Year	*Vehicle Size Group* (1)	(2)	(3)	(4)	Total
t_0	+ 236	+ 296	—	+ 88	+ 620
t_1	+ 270	+ 339	—	+ 101	+ 710
t_2–t_{30}	+ 304	+ 382	—	+ 114	+ 800
Unclassified Roads					
t_0–t_{30}	− 177	− 222	—	− 68	− 467

TABLE 13.10

Annual Net Cost of Relocation: Area C

Two year Re-employment Lag	£	Zero Re-employment Lag	£
t_0	153	t_0–t_{30}	333
t_1	243		
t_2–t_{30}	333		

Area D

13.2.31 Proportion of households with at least one car: 86%
Average number of cars per household: 1·0
Breakdown into size groups:

(1) 25·0%
(2) 55·6%
(3) 13·9%
(4) 5·5%

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Existing Types of Journey

TABLE 13.11

Effect of Relocation on Annual Mileage: Existing Journeys by Private Car: Area D

Relocation Site	Classified Roads	Unclassified Roads	Total
Acton Burnell	− 77,177	+ 25,194	− 51,983

13.2.32 This reflects the fact that if relocated in Acton Burnell, people would tend to substitute journeys on unclassified roads, particularly to Shrewsbury, for those along the A458.

Other Journeys

13.2.33 47 out of 74 full-time farm workers would be made redundant by relocation. The same assumptions are made regarding the proportion of journeys to work involving private car costs, destinations and time unemployed as for Areas B and C.

TABLE 13.12

Effect of Relocation on Aggregate Annual Mileage (Private Cars): Area D

Year	Classified Roads	Unclassified Roads	Total
t_0	− 77,177	+ 108,889	+ 31,712
t_1	− 77,177	+ 142,169	+ 64,992
t_2–t_{30}	− 77,177	+ 175,449	+ 98,272

Summary: Area D

TABLE 13.13

Effect of Relocation on Annual Operating Costs of Private Cars: Classified Roads: Area D (£)

Year	*Vehicle Size Group* (1)	(2)	(3)	(4)	Total
t_0–t_{30}	− 249	− 697	− 210	− 104	− 1,260
Unclassified Roads					
t_0	+ 363	+ 1,008	+ 309	+ 154	+ 1,834
t_1	+ 474	+ 1,316	+ 403	+ 201	+ 2,394
t_2–t_{30}	+ 585	+ 1,625	+ 498	+ 248	+ 2,956

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TABLE 13.14
Annual Net Cost of Relocation: Area D

Two Year Re-employment Lag		Zero Re-employment Lag	
	£		£
t_0	574	t_0–t_{30}	1,696
t_1	1,134		
t_2–t_{30}	1,696		

Summary: All Areas

TABLE 13.15(A)
Annual Net Cost of Relocation
Private Cars: Operating Costs
2-Year Re-employment Lag (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0	767	153	573	920	1,341	727	1,494
t_1	1,384	243	1,134	1,627	2,518	1,377	2,761
t_2–t_{30}	2,003	333	1,696	2,336	3,699	2,029	4,032

TABLE 13.15(B)
Zero Re-employment Lag (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	2,003	333	1,696	2,336	3,699	2,029	4,032

13.3. Public Transport

13.3.1 In the preceding sub-section the length of journeys undertaken by private car before relocation was compared, on the assumption that there would be no substitution of one form of transport for another, with the length of journeys made after relocation. This approach is necessarily retained in dealing with public transport; we therefore examined the effect relocation would have on the cost of conveying people resident in B, C and D who currently travel by bus, plus a proportion of displaced farm workers who would now travel by bus to their new places of employment.

Existing Bus Travellers Resident in B, C and D

13.3.2 Even if we restrict ourselves to the existing number of bus travellers, there are circumstances in which bus operators' costs could be affected by relocation, which might require the abandonment of some routes and the introduction of others. However, it should be emphasised that in the present kind of study the criterion for deciding if a given route should be deemed to be abandoned or introduced should not be its *profitability*. Rather, the decision should rest on whether or not retention or introduction of a route is necessary

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to ensure that after relocation people hitherto using public transport should be permitted to continue to do so if they wished. For example, suppose that the social cost-benefit calculation showed that relocation would yield a net benefit, whilst retaining the same standard of amenity in the area, and society decided to allow relocation to proceed. It would then be possible for society to subsidise, out of the gains accruing from the scheme, any bus operator who as a result would have to run a given service at a loss.

13.3.3 As far as existing bus travellers are concerned, relocation would have no effect on bus operators' costs or routes. This is basically because relocation would involve little more than shifting people along existing routes that pass through the area from outside. Roughly, the main lines of communication run north to south, and population shifts would operate in the same direction.

New Journeys

13.3.4 The only new journeys that have to be considered in this study are those which, as a consequence of relocation, would be unavoidable. These consist of journeys to work (assumed to be at Shrewsbury) made by displaced farm workers. Previous calculations were made on the basis that 50% of such journeys would involve private car costs; the remainder are now assumed to be divided equally between those made by bus and those undertaken as car passengers. Under the assumption of a two-year re-employment lag, the number of additional bus passengers would then be as indicated in Table 13.16. As before, if the zero re-employment lag is assumed, the data for t_2–t_{30} would apply to t_0–t_{30}.

TABLE 13.16

Additional Bus Passengers (Redundant Farm Workers)

Year	*B*			*C*	*D*
	Acton Burnell	Leebotwood	Longnor	Leebotwood	Acton Burnell
t_0	1	2	1	—	4
t_1	2	3	2	1	8
t_2–t_{30}	4	5	4	2	12

13.3.5 As far as people relocated in Leebotwood and Longnor are concerned, there would be no effect on bus costs. The additional passengers could be absorbed quite well in view of the small numbers involved and of the frequency of bus services along the A49. Acton Burnell is a different matter however; currently, there is no bus service that would allow daily journeys to work in Shrewsbury to be made. Whether or not a bus operator would in fact find it profitable to provide such a service, we still have to estimate how much it would cost to do so. This estimate would be necessary for the B and/or D relocation solutions, even though, should relocation apply to B alone, a maximum of only four people would be involved.

13.3.6 The nearest major bus route to Acton Burnell village runs along the A458 between Much Wenlock and Shrewsbury, and in the following calculation

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it is assumed that the Acton Burnell passengers would be accommodated by diverting buses from this route. In the absence of knowledge of the incomes, purpose of journeys, etc., of the passengers from outside the study area who currently travel by this route, and whose journeys would now be prolonged, the cost of diversion had to be estimated by using formulae provided by the R.R.L., which are based on average data, and standard occupancy rates. The cost of diverting buses from their present route to Acton Burnell village and back again was in fact estimated according to the formula of $10{\cdot}8 + \frac{337}{S}$ pence per mile.[1] S(speed) is reckoned on such a road at 10 m.p.h., the cost therefore being 44·5 pence per mile.

13.3.7 This formula differs from the preceding ones in that it includes not only vehicle operating costs but also the value of working time of passengers and bus crews, although non-working time continues to be valued at zero. However, the time element of cost is applied only to persons living *outside* the study area: consideration of the value of the time of travellers resident in Areas B, C and D is reserved for the following section.

13.3.8 Assuming two visits to Acton Burnell in the morning and two in the evening, for five days per week (a total of 6,760 miles a year), the annual cost of relocation would be as shown in Table 13.17.

TABLE 13.17

Additional Annual Costs of Public Transport

Operating Costs Plus Working Time of Non-Residents (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	1,253	—	1,253	1,253	1,253	1,253	1,253

13.3.9 This cost would be incurred whichever assumption is made about the re-employment time lag.

General

13.3.10 Discussion with the major bus operator in the region suggested that, if the sole criterion were profitability, relocation would have a negligible effect and bus routes would not be altered to accommodate the new situation. This is mainly because both the number of households involved and the distances between existing settlements and relocation sites are so small. This would continue to apply even if journeys to Shrewsbury by displaced farm workers are included. (Costs of conveying children to school on major bus routes are discussed elsewhere, but for the moment suffice to say that their inclusion does not materially affect this conclusion either.)

[1] This is for speeds < 30 m.p.h. The appropriate formula for speeds ≥ 30 m.p.h. is $11{\cdot}9 + \frac{302.}{S}$

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13.3.11 Furthermore, officials of the 'Midland Red' considered that even if we allowed for the possibility that upon relocation people would substitute one form of transport for another, the effect would be too small to require the alteration of bus routes. This view is reinforced by the high proportion of car ownership in the area, to which we have already referred. On the other hand, relocation of population in concentrated settlements would no doubt encourage some people to make journeys where none were made before. This could be particularly important for housewives, who might now make more frequent shopping trips, probably at off-peak periods. A side effect of relocation, as far as the nature of the present study is concerned, would therefore be an improved level of amenity in this respect and, perhaps, increased profits for bus operators.

13.4. Time Spent in Travelling by Public and Private Transport

Working Time (W.T.)

13.4.1 If the procedure used by the R.R.L. is adopted, and journeys to and from work are excluded from the category, the only W.T. affected by relocation would be that of farmers in making business trips.[1] The general method would have been to estimate the change in the amount of time spent on such journeys and to value this at the agricultural wage rate.

13.4.2 In fact, analysis of this kind of journey soon made it clear that changes in the value of W.T. would be negligible. This is for two main reasons. First, for reasons outlined in Appendix III, we were only concerned with retained farmers, the value of displaced farmers' time being allowed for separately. Secondly, the method used to compare journeys on days when business trips were made was to compare the return journey between farm and market with the single journeys home to farm, to market, and home again,[2] and the difference between them was negligible.

13.4.3 This is explained by the fact that Shrewsbury is by no means as strong a focal point for the business interests of the farming community as it is for the remainder of journeys made in the area; Church Stretton, Craven Arms, Wellington, Much Wenlock and Bridgenorth all exert a strong countervailing influence. Since direct journeys between existing farms and market would continue to be necessary after relocation, there is little reason to suppose that destinations would change. As a generalisation, relocation would mean shorter distances to Shrewsbury, this being offset by roughly the same amount by longer distances to the other towns mentioned. This applies equally to B, C and D.

13.4.4 No estimates were therefore made under this heading.

Non-Working Time (N.W.T.)

13.4.5 Since transport economists have as yet not satisfactorily resolved the problem of how to evaluate N.W.T. spent in travelling, two sets of estimates were made:

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[1] An exception is that where changes in bus routes are involved, the time of bus crews also has to be allowed for. This was done in the previous section.

[2] See Appendix III for an explanation of this. (On such days no attempt was made to distinguish between business journeys and journeys to work. Conceptually, this is at best a hazardous process, and is particularly difficult in respect of farmers.)

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(a) where N.W.T. is valued at $\frac{3}{4}$ the value of the appropriate W.T., and
(b) where N.W.T. is valued at zero.[1]

13.4.6 As in the section dealing with vehicle operating costs, both (a) and (b) are sub-divided according to the different assumptions regarding the re-employment time lag; as before, data for t_2–t_{30} for the two-year redundancy assumption shown in the following tables would apply to t_0–t_{30} for the no-redundancy hypothesis.

(a) N.W.T. = $\frac{3}{4}$ W.T.

13.4.7 Ideally, estimation of the effect relocation would have on the value of N.W.T. spent in travelling would require knowledge of the change in mileage covered by different income groups. As a rule of thumb guide, however, we had to make do with a rough division of travellers into two groups: farmworkers (retained and displaced)[2] and 'others'.

13.4.8 The travel survey revealed, for private cars, a mean occupancy rate for the whole area of 1·1 adult persons per vehicle-mile. The assumptions upon which we worked were that this would persist, after relocation, for existing types of journey, but that for 'new' journeys (made by retained and displaced farmers) an average occupancy rate of 1·0 would be nearer the mark.

13.4.9 The travel survey also showed that, for the whole area, roughly one-quarter of occupant-miles were attributable to adult non-earners (pensioners and housewives). Since we wanted to confine our attention to employed persons' travelling time, the relevant additional mileage covered in each of B, C and D was therefore estimated as $\frac{3\,(1{\cdot}1)}{4}$ M + N, where M = additional mileage on existing types of journey and N = additional mileage on new journeys. Allocatin on a simple *pro rata* basis between classified and unclassified roads, the result o this was as follows:—

TABLE 13.18

Additional Annual Mileage: Earner-Occupant-Miles (Private Cars)

Year	*Area Relocated*				
	B		C		D
	Classified	Unclassified	Classified	Unclassified	Classified
t_0	− 1,726	58,171	34,157	− 22,891	− 63,67
t_1	24,950	69,871	39,929	− 22,891	− 63
t_2–t_{30}	51,626	81,571	45,701	− 22,891	− 63

[1] In *Research on Road Traffic, op. cit.* the R.R.L. present two sets these two assumptions. Current procedure used by the Ministry of T value *all* N.W.T. at 3/- per hour.

[2] Displaced farmworkers' time is assumed to be equal in value to retained f time. This is implicit in the agricultural calculations, to the extent that the wage agricultural employment is taken as a measure of the 'opportunity cost' of labour so its marginal net product if employed elsewhere.

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13.4.10 Net additional earner-occupant-miles are therefore greater than the corresponding increase in vehicle miles.[1] This is because more weight is given to new journeys (a factor of one being used) which by definition are additional, than to existing journeys (0·825), which would be reduced should relocation take place.

13.4.11 In translating the above data into money terms, the first step was to divide travellers into two occupational groups: farmworkers and others. All new journeys would be made by farmworkers, but changes in existing types of journey were allocated between the two groups in proportion to their importance in the occupational structure of heads of households in the whole area, the overall proportion of farmworkers in fact being roughly 75%. Retaining our assumptions of 40 m.p.h. for classified and 30 m.p.h. for unclassified roads, we now show the additional mileage covered and time spent in travelling by the two groups.

TABLE 13.19

Additional Time and Mileage: Private Cars

Farmers and Others

	Farmers			*Others*		
	Mileage		Time (hours)	Mileage		Time (hours)
	Classified	Unclassified		Classified	Unclassified	
	(1)	(2)	(3)	(4)	(5)	(6)
Area B						
t_0	+ 6,096	+ 62,331	+ 2,230	− 7,822	− 4,160	− 334
t_1	+ 32,772	+ 74,031	+ 3,287	− 7,822	− 4,160	− 334
t_2–t_{30}	+ 59,448	+ 85,731	+ 4,344	− 7,822	− 4,160	− 334
Area C						
t_0	+ 27,061	− 15,372	+ 164	+ 7,096	− 7,519	− 73
t_1	+ 32,833	− 15,372	+ 308	+ 7,096	− 7,519	− 73
t_2–t_{30}	+ 38,605	− 15,372	+ 453	+ 7,096	− 7,519	− 73
Area D						
t_0	− 47,753	+ 99,284	+ 2,116	− 15,918	+ 5,196	− 225
t_1	− 47,753	+ 132,564	+ 3,225	− 15,918	+ 5,196	− 225
t_2–t_{30}	− 47,753	+ 165,844	+ 4,334	− 15,918	+ 5,196	− 225

13.4.12 Changes in the time spent travelling by bus were also investigated. These consisted of reductions or additions because existing travellers were moved along a particular bus route, as well as additions due to the new bus journeys undertaken by displaced farmworkers and the consequent diversion of existing bus routes. In fact, the travel survey revealed that employed people in Areas B, C and D scarcely ever travel by bus, and relocation would therefore have a negligible effect as far as existing types of journey are concerned. There would be a considerable change in N.W.T. spent in travelling by displaced

[1] See Tables 13.4, 13.8 and 13.12.

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farmworkers though, as comparison of column (3) of Table 13.19 and column (1) of Table 13.20 shows.

TABLE 13.20

Additional N.W.T. Spent Travelling by Private Car and Bus:

Residents of Relocated Areas (hours)

	Farmers (1)	Others (2)
Area B		
t_0	3,858	− 334
t_1	6,543	− 334
t_2–t_{30}	9,228	− 334
Area C		
t_0	164	− 73
t_1	629	− 73
t_2–t_{30}	1,095	− 73
Area D		
t_0	3,744	− 225
t_1	6,481	− 225
t_2–t_{30}	9,218	− 225

13.4.13 Farmers' time was then valued at 4/– per hour (roughly ¾ of the standard hourly wage rate for farmworkers), but inspection of the occupational structure of the non-farming community suggested that the N.W.T. spent by 'others' in travelling should be valued at a higher rate. An arbitrary sum of 7/6 per hour was selected, which corresponds roughly to a salary of £1,000 per annum.

13.4.14 For residents of B, C and D, the total additional cost of N.W.T. spent in travelling as a result of relocation is therefore estimated as shown in Table 13.21.

TABLE 13.21

Cost of Relocation: N.W.T.

Residents of Relocated Areas (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0	647	6	665	653	1,312	671	1,318
t_1	1,184	99	1,212	1,283	2,396	1,311	2,495
t_2–t_{30}	1,721	192	1,760	1,913	3,481	1,952	3,673

13.4.15 The possible failure of displaced farmworkers to obtain alternative employment is allowed for in Table 13.21, and as a consequence the N.W.T. costs are observed to grow over time, but if this hypothesis is accepted the above may slightly over-estimate the cost of N.W.T. in years t_0 and t_1. This is because the time spent by displaced farmworkers on journeys for leisure, shopping purposes, etc., has not been deducted. Strictly speaking it should be, for as unemployed people their N.W.T. would have no identifiable monetary value:

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however, this was ignored, as it was evident that the sums involved would be negligible.[1] (This point is clearly not relevant where the assumption is made of a zero re-employment time lag.)

13.4.16 Finally, we have to take account of the additional N.W.T. spent in travelling by people already using those buses that have to be diverted to pick up the Acton Burnell passengers. It will be noted that the N.W.T. spent in travelling on this bus route by displaced farmworkers has already been included in Table 13.21: double counting will therefore only be avoided if in fact prior to their diversion, the buses had 'normal' occupancy rates and if the formulae provided by the R.R.L. were already applicable. Assuming that this is so, the cost per mile in terms of the N.W.T. of the passengers residing outside the study area was estimated at $\frac{982}{S}$, or 98·2 pence,[2] where N.W.T. is valued at $\frac{3}{4}$ W.T.

The cost of relocation is shown in the following table:—

TABLE 13.22
Annual Cost of Relocation: N.W.T. of Non-Resident Bus Passengers (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	2,766	—	2,766	2,766	2,766	2,766	2,766

13.4.17 This cost will be incurred whichever assumption is made concerning the re-employment time lag.

13.4.18 In conclusion, where N.W.T. is valued at $\frac{3}{4}$ W.T., the net cost of relocation is determined, after having made the necessary adjustments for redundancy assumptions, by summation of the entries in Tables 13.15, 13.17, 13.21 and 13.22.

(*b*) *N.W.T.* = 0

13.4.19 If N.W.T. is valued at zero, the net cost of relocation is simply the sum of the entries in Tables 13.15 and 13.17, again after adjusting for redundancy assumptions.

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[1] As a theoretical point, the fact that the employment of a proportion of (retained) farmworkers involves no opportunity cost does not therefore mean that savings in their time is of no value.

[2] This was estimated as follows. The 1963 formulae for costs per mile of public service vehicles, at speeds <30 m.p.h., are given in *Research on Road Traffic, op. cit.* as $9{\cdot}3 + \frac{283}{S}$ pence where N.W.T. = 0 and $9{\cdot}3 + \frac{1{,}097}{S}$ pence where N.W.T. = $\frac{3}{4}$ W.T. This was updated to 1966 prices by use of data on *per capita* incomes before tax, occupancy rates being assumed unchanged. This gave $\frac{982}{S}$ for the value of N.W.T., as compared with the R.R.L's present formula, where N.W.T. for all passengers is valued at 3/- per passenger-hour, of $\frac{635}{S}$.

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13.5. Summary

13.5.1 The aggregate net cost of relocation in terms of operating costs of private cars and public transport and, where applicable, of the value of W.T. and N.W.T. spent in travelling by these methods, is shown in Tables 13.23(A) to 13.23(D), each table being constructed on the basis of different assumptions concerning the value of N.W.T. and the re-employment time lag.

TABLE 13.23(A)

Aggregate Net Cost of Relocation: Travel Costs (£)

Two-Year Re-employment Lag: N.W.T. = ⅓ W.T.

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0	5,433	159	5,258	5,592	6,672	5,417	6,831
t_1	6,587	342	6,365	6,929	8,933	6,707	9,275
t_2–t_{30}	7,743	525	7,475	8,268	11,199	8,000	11,724

Present Worth Equivalent

Discount Rate	B	C	D	B + C	B + D	C + D	B+C+D
6%	110,925	7,213	107,104	118,138	158,689	114,317	165,902
8%	91,531	5,900	88,381	97,431	130,649	94,281	136,549
10%	77,375	4,942	74,716	82,317	110,185	79,658	115,127
12%	66,771	4,225	64,478	70,996	94,856	68,703	99,081

TABLE 13.23(B)

Two-Year Re-employment Lag: N.W.T. = 0 (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0	2,020	153	1,827	2,173	2,594	1,980	2,747
t_1	2,637	243	2,387	2,880	3,771	2,630	4,014
t_2–t_{30}	3,256	333	2,949	3,589	4,952	3,282	5,285

Present Worth Equivalent (£)

Discount Rate	B	C	D	B + C	B + D	C + D	B+C+D
6%	46,255	4,652	41,890	50,907	69,644	46,542	74,296
8%	38,102	3,819	34,506	41,921	57,248	38,325	61,067
10%	32,151	3,210	29,116	35,360	48,203	32,326	51,413
12%	27,694	2,755	25,079	30,449	41,427	27,834	44,182

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TABLE 13.23(C)

Zero Re-employment Lag: N.W.T. = ¾ W.T. (£)

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	7,743	525	7,475	8,268	11,199	8,000	11,724

Present Worth Equivalent (£)

Discount Rate	B	C	D	B + C	B + D	C + D	B+C+D
6%	114,325	7,752	110,368	122,077	165,353	118,120	173,105
8%	94,911	6,435	91,626	101,346	137,274	98,061	143,710
10%	80,736	5,474	77,942	86,210	116,772	83,416	122,245
12%	70,113	4,754	67,686	74,867	101,407	72,440	106,162

TABLE 13.23(D)

Zero Re-employment Lag: N.W.T. = 0 (£)

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	3,256	333	2,949	3,589	4,952	3,282	5,285

Present Worth Equivalent (£)

Discount Rate	B	C	D	B + C	B + D	C + D	B+C+D
6%	48,075	4,917	43,542	52,992	73,116	48,459	78,033
8%	39,911	4,082	36,148	43,993	60,700	40,230	64,783
10%	33,950	3,472	30,749	37,422	51,635	34,221	55,106
12%	29,483	3,015	26,703	32,498	44,840	29,718	47,856

13.5.2 It will be observed that the sum of individual area costs does not always equal the aggregate cost if those areas are relocated together. This is because, for Areas B and D, additional bus transport costs, including W.T. and N.W.T. of bus crews and passengers on diverted routes, are 'joint' to both.

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14. Miscellaneous Transport Effects

14.1. Services Examined

14.1.1 Throughout this chapter it is convenient to present estimates, not of the total cost of providing services before and after relocation, but merely the net benefit of relocation or net cost as the case may be. Services involving the use of transport are as follows: health and welfare, libraries, refuse collection, school transport, mobile shops and miscellaneous deliveries, and farm suppliers. Road construction and maintenance are also briefly discussed.

14.2. Health and Welfare Services

Ambulances

14.2.1 The Shropshire County Council Ambulance Service has its headquarters and central control at Shrewsbury, but vehicles are also operated from stations at Bridgnorth, Craven Arms, Donnington, Market Drayton, Much Wenlock, Oswestry and Whitchurch. Over 50 vehicles are used, the bulk of these being ambulances, the remainder being comprised of sitting-case cars and dual purpose vehicles.

14.2.2 The object of this section is to outline the method used to estimate the effect of relocation on the length of ambulance journeys and on the time spent in travelling by ambulance crews. The nature of the ambulance service, however, is such that it is not possible to identify set routes, in the light of which pre- and post-relocation situations can be compared, and further complexity is added by the fact that ambulances from any one of the stations mentioned may be used to transport patients to, from or through the study area.

14.2.3 Consequently, the method used to estimate the effect of relocation was to take a sample period of one month and then to trace, from the Ambulance Officer's records, every journey made during that month by each ambulance in the county. Details of ambulance routes passing through or close to the study area were then abstracted. Having done this, the mileage covered during each day of the sample period was compared with the mileage that would have been covered if people had been relocated.

14.2.4 Two approaches were used. The first assumed that, if from the data on daily routes travelled by vehicles during the sample period, it appeared that a patient currently transported by ambulance X could, upon relocation, be carried more cheaply by adjusting ambulance Y's recorded route for that day, this would in fact be done. This method provides a maximum estimate of the saving achieved or a minimum estimate of the additional cost resulting from relocation.[1] This, however, may be unsatisfactory because it does not allow for emergency

[1] Although perhaps not an overall maximum or minimum for the whole region covered by the Shropshire C.C. Ambulance Service, for still further repercussions might be felt outside the study area.

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journeys, in which case the fact that ambulance Y passes close to X's route *on the same day* is insufficient to consider that travel by Y is an adequate substitute for travel by X. Moreover, this procedure does not allow for the possibility that ambulance Y might be unable to accommodate any more passengers.

14.2.5 The cheapest practical solution might therefore simply be for X's recorded route to be adapted to meet the new situation; a not unrealistic alternative in view of the short distance between existing dwellings and the relocation sites. The second approach relied upon this assumption and thus provided a more conservative estimate of savings (or a higher estimate of additional costs) resulting from relocation.

14.2.6 In fact, the investigation showed that whichever approach was used, the effect of relocation on ambulance costs would be negligible. This was not only because the number of calls to properties in the area was insignificant (in B, C and D a total of only four in the sample month), but also because on the rare occasions ambulances did visit these properties they were passing through the area anyway, and scarcely any diversion was required. Thus, further illustration is provided of a point of general applicability: if the study area is geographically situated in the middle of a region throughout which one authority is responsible for providing a given service, savings brought about by relocation will normally be less than if it was situated on the fringe.

14.2.7 If relocation had appeared to have an important effect on ambulance journeys, closer attention to the relative merits of the two approaches used would be required, but in the circumstances this was not necessary. No estimates were therefore made of the effect on ambulance running costs or on the cost of time spent in travelling by ambulance crews.

Other Medical Services

14.2.8 Estimates of journeys made by district nurses, midwives, health visitors and doctors were also made. Where possible, information concerning existing journeys and frequency of visits to patients' homes in Areas B, C and D was obtained by interview and examination of journey records on a sample-month basis. The information thus obtained was very sketchy, and the estimates in Table 14.1 can only be a rough guide to the magnitudes involved. The effect of relocation is based upon the difference between the distances that would be covered *between patients' homes* in the pre- and post-relocation situations and, as such, relocation cannot show a net cost on this account. In practice, the total journey made, including that to and from the place of residence of the person making it, would be crucial in determining whether or not relocation would yield a net cost or saving. The place of residence, however, simply cannot be taken as given and, *prima facie*, there are grounds for supposing that concentration of population around existing villages would result in persons living in the neighbourhood becoming responsible for the health services mentioned in this section. The figures in Table 14.1 are therefore likely to be minimum estimates of the savings accruing from relocation.

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TABLE 14.1

Annual Savings: Medical Services (£)

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	50	—	20	50	70	20	70

Car operating costs were calculated on the assumption that typically the cars used for journeys of this nature fell into the 1,001 to 1,500 c.c. category,[1] and the cost of working time spent in travelling was determined by the salaries applicable to the professions involved.

Miscellaneous Welfare Services

14.2.9 Brief attention was paid to welfare services organised by such diverse bodies as the Shropshire County Council, the W.R.V.S. and the Church Mission for the Deaf. It was soon apparent that the costs of providing such services in Areas B, C and D were insignificant, the fact that calls in the area could be made on the way to destinations beyond the study area again being an important reason. Journeys made by local residents for the W.R.V.S. could be important, but these would have been included in our estimates of private travel costs. This would apply to 'Meals on Wheels', the hospital car service and the handicapped children service. No estimates were therefore made on this account.

14.3. Mobile Libraries

14.3.1 Mobile library facilities provided fortnightly by the Shropshire County Council cover the study area quite extensively. The object of this section is to determine the savings in vehicle operating costs and in the value of working time of the drivers and librarians manning library vehicles should relocation take place.

14.3.2 One important thing to note in this context is that in some circumstances relocation might encourage local authorities to construct permanent libraries at or near to the relocation sites, rather than to continue to provide the inferior mobile service. Inferiority of the mobile library is clearly due to the smaller stock of books that can be carried, as well as the lack of time for people to select the books they wish to borrow; a consequence of relocation might therefore be an improvement in this respect. For the reasons we have outlined elsewhere, however, it is not part of the present study to make allowance for this contingency. The following table provides estimates of the savings that would be effected by relocation in the cost of providing library facilities of an equivalent standard to those now available.

14.3.3 The general formulae provided by the R.R.L. were not used in this case, the costs per mile being estimated from data provided by the County Librarian

[1] See paragraph 13.2.10.

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on librarians' salaries, drivers' wages and vehicle running costs. Assuming an average speed of 15 m.p.h. for mobile libraries on the unclassified roads in the study area (journeys on major roads were irrelevant in this context), and making adjustment for transfer items and non-marginal expenditure, the cost per mile was estimated at roughly two shillings. The only time savings estimated applied to travelling time: the total length of time actually spent in dealing with the public was assumed to remain unchanged.

14.3.4 The results are shown in Table 14.2, their insignificance once more being partly explained by the fact that existing mobile library routes pass through the study area, and to some extent would continue to do so even if it was depopulated. Again, these are minimum estimates of the savings accruing from relocation, and repercussions elsewhere are ignored. Since one of the existing routes passes through Areas B and D, it will be noted that the sum of the savings for the individual areas is less than the saving achieved by relocation of a combination of them.

TABLE 14.2

Annual Savings: Library Services (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	5	—	14	5	21	14	21

14.4. Refuse Collection

14.4.1 Refuse collection and disposal is the responsibility of the Atcham R.D.C. Collections are made fortnightly by a team consisting of the driver of the refuse collection vehicle and two loaders.

14.4.2 Information supplied by the Atcham R.D.C. public health department was used for the wage rates of drivers and loaders and, adjusting for tax and non-marginal expenditures, for vehicle running costs as well. As in the case of mobile libraries, we were concerned only with the distance and time spent in travelling between properties in the pre- and post-relocation situations, the time spent in actually loading the refuse being assumed to remain unchanged.

14.4.3 Assuming an average speed of 15 m.p.h. on the unclassified roads linking properties in Areas B, C and D, a cost of 2/8 per mile was estimated. On this basis the annual savings accruing from relocation were as follows:—

TABLE 14.3

Annual Savings: Refuse Collection (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	59	21	66	80	125	87	146

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14.4.4 Present refuse collection routes do not overlap our Areas B, C and D, so the sum of individual area savings equals the saving achieved by relocating a combination of them. The study area is on the fringe of the Atcham R.D.C. boundary, so the savings, with one exception, are not reduced by the fact that journeys would be made through the area even if depopulation took place. The exception is provided by the retention of certain properties in Cardington village, which is at the southerly extreme of Area B. If the whole of Cardington village were depopulated, the savings for Area B on this account would be nearly doubled. The optimal solution in respect of refuse collection, or indeed of any services currently provided by the R.D.C., might therefore be for Cardington to be absorbed into Ludlow R.D. if depopulation of the remainder of Area B took place.

14.5. School Transport Facilities

14.5.1 Information concerning the present means of transporting children in the area to the schools listed in Chapter 12 was provided by the Shropshire County Council Education Department. The outstanding feature of school transport facilities in the region is the wide variety of vehicles employed for this purpose. Children may travel the whole distance from home to school by bus, minibus, taxi or private car, or they may be taken by minibus, taxi or private car from home to link up with major bus routes or other taxis or minibuses.

14.5.2 The Education Department estimated the costs presently incurred and those that would be incurred in conveying children to school if relocation took place. The assumptions concerning the extension and closure of schools were as described in Chapter 12. Repercussions which were taken into account included the shortening of some routes, the extension of others and the substitution of one form of transport for another. Estimates of non-marginal costs and transfer items were subtracted from the costs incurred by the County Council in paying for bus season tickets, taxis and private cars used for taking children to school, as well as in operating their own minibuses. The results are shown in Table 14.4.

TABLE 14.4

Annual Savings: School Transport (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	340	232	− 75	572	513	157	745

14.5.3 The importance of overlapping routes is demonstrated by the figures for B and D, in which the sum of individual savings of £265 is changed into a net saving of £513 if both areas are relocated together. There would be no overlaps of importance between Areas B and C before or after relocation.

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14.5.4 In passing, it should be said that relocation appears to be a more favourable proposition in social terms than it would be if the costs actually borne by the County Council were used as a measure of its effect. This is because relocation would result in the substitution of certain expenditures that are of a purely accounting nature, for expenditures that involve the use of real resources. For example, relocation of people currently residing in B would mean that a greater cost would be incurred in paying for season tickets on scheduled bus routes, but less is paid for hiring taxis. The latter is treated as a real saving, but the former is not treated as a real cost. The implication of this is that sufficient spare capacity is considered to exist to allow buses to accommodate the additional numbers without the need for extra services to be laid on.

14.6. Mobile Shops and Miscellaneous Deliveries

14.6.1 In the course of the private travel survey, householders were asked to provide information concerning deliveries of milk, bread, meat, groceries, newspapers, etc. In addition, information was sought from certain shopkeepers in the surrounding areas who operated mobile shops. As a result, a comprehensive picture of the system of delivering goods of this nature was built up for the area.

14.6.2 In view of the diverse nature of vehicles employed, the following R.R.L. formulae, including an allowance for working time, were used:—

Light commercial vehicles: $4{\cdot}4 + \frac{154}{S}$ ($S < 40$ m.p.h.)

Medium commercial vehicles: $5{\cdot}6 + \frac{162}{S}$ ($S < 30$ m.p.h.)

14.6.3 Average speeds (excluding the time the vehicles are at rest, which was assumed as a rough approximation to be the same before and after relocation) were estimated at 25 m.p.h. for light and 20 m.p.h. for medium commercial vehicles. Costs per mile were therefore estimated at 10·5 and 13·7 pence respectively.

14.6.4 Similar considerations apply to mobile shops as to mobile libraries in that relocation would doubtless encourage their replacement by the construction of permanent shops or extension of existing ones; relocation would therefore be likely to result in a standard of amenity for displaced persons higher than that existing beforehand. As before, this possibility was not pursued further. The effects of relocation were therefore calculated simply by estimating the mileage covered in serving customers where they live now, and comparing this with the mileage covered if relocation took place. On occasion it was assumed that different tradesmen would serve displaced households after relocation: this was not always so because sometimes the same tradesmen already serve both the existing settlements and the appropriate relocation sites. A problem arises in that if, for example, the mobile grocery serving a given household were to be changed there would clearly be an alteration in the standard of service: this,

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however, is unavoidable and we have had to make the rather unsatisfactory assumption that one mobile shop of a given general type is as good as another.

14.6.5 The results of the calculations are shown in Table 14.5, which provides estimates of mileage and cost savings for the possible relocation situations.

TABLE 14.5

Annual Savings: Mobile Shops, etc.

Reduction in mileage	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B + C + D
Light commercial ...	1,089	1,143	118	2,232	6,029	1,261	7,172
Medium commercial	1,418	52	652	1,470	3,734	704	3,786
TOTAL ...	2,507	1,195	770	3,702	9,763	1,965	10,958
Cost Saving (£) t_0-t_{30}	129	53	42	182	477	95	530

14.6.6 Because routes currently overlap Areas B and D, the sum of the savings achieved by depopulating these areas individually is much less than that should both areas be depopulated together. This does not apply to B and C.

14.7. Farm Suppliers, etc.

14.7.1 Relocation would involve a reduction in the number of farms, and therefore, presumably, a reduction also in the mileage covered by vehicles visiting farms for commercial purposes. Since farmers indirectly bear the cost of this mileage, this has already been allowed for in the estimates concerning the agricultural repercussions of relocation, which incorporate the lower fixed costs resulting from amalgamation into larger units.

14.8. Road Construction and Maintenance

14.8.1 If relocation took place, the road system presently serving Acton Burnell, Leebotwood and Longnor should be capable of accommodating the consequent increase in traffic in the neighbourhood of these villages. Since the cost of the estate roads themselves is included in the housing estimates, no separate calculations are made of the cost of road construction necessitated by relocation.

14.8.2 If Areas B, C and D were depopulated, the roads located therein would continue to be used either as through routes, or by farmers who continue to work there, or by the weekend travellers and holidaymakers who frequent the area, particularly in the summer months. However, as we have seen, there would be certain changes in the mileage covered on those roads by vehicles of different types.

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14.8.3 Little is known of the functional relationship between vehicle mileage and the cost of road maintenance, but there are grounds for believing that relocation would have a negligible effect on road maintenance costs. This is for two main reasons. First, the average total costs of maintenance and repair, signposting, etc., as provided by Roth[1] are insignificant in relation, for example, to vehicle running costs. Roth in fact provides figures for 1961 and 1962, the estimates for the two years being calculated on different bases and applicable only to trunk and classified roads. Estimates vary from 8d. to 11d. per 100 miles for cars and taxis, and 50d. to 60d. per 100 miles for heavy goods vehicles.

14.8.4 These, however, are a very crude guide, for they are, in Roth's words, '. . . probably not relevant for the under-used half of the British road system which carries only 5% of total vehicle mileage', and the greater part of the road mileage concerned in this study falls, of course, into the latter category. Nevertheless, although one might expect the average total cost per vehicle mile on the under-used roads to be higher than that quoted by Roth, there is no reason to suppose that the *marginal* cost is higher—and it is the marginal cost that is relevant for the present study.

14.8.5 Not only do average total costs appear to be relatively small, but a proportion of them are, in respect of vehicle mileage, non-marginal. Others may or may not be, the influences of weather and time not being properly understood. Normally, one might expect road maintenance costs to increase as vehicle mileage increases, as Roth's figures show. However, in the case of narrow country lanes of the sort to be found in the study area—which are not, understandably, of great interest to transport economists—it is conceivable that certain types of expenditure, such as that on verge maintenance, could vary inversely with the rate of traffic flow. For U.K. roads in 1964, Roth in fact uses an arbitrary figure of 25% as the proportion of the cost of road maintenance and repair that is incurred independently of the extent of road use. At all events, the estimates quoted above would seem to be very much an upper limit to the marginal costs of road maintenance.

14.8.6 A second reason which applies more specifically to the consequences of relocation in this particular case is that, as we have shown, an increase in private car mileage would be offset to some degree by a (smaller) reduction in medium and heavy vehicle-miles, the marginal cost of which, in terms of road maintenance, appears to be considerably higher than for the lighter vehicles.[2] It is thus possible that relocation could show either a net cost or a net benefit on this account. In the absence of more useful data on road costs, therefore, no estimates were made, but the foregoing suggests that the magnitudes that would be involved are not such as to make this a significant omission.

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[1] G. J. Roth: *A Self-Financing Road System*, Institute of Economic Affairs, 1966.

[2] No estimates were made of the effect relocation would have on the actual mileage covered by certain categories of heavy vehicle. A reduction in heavy vehicle mileage is implicit, among other things, in our assumption of farm economies of scale that would follow amalgamation; the mileage covered by sewage collection vehicles, similarly, is not explicitly defined in the study.

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14.9. Summary

TABLE 14.6

Annual Savings: Miscellaneous (£)

Transport Effects

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	583	306	67	889	1,206	373	1,512

Present Worth Equivalent (£)

Discount Rate	B	C	D	B + C	B + D	C + D	B+C+D
6%	− 8,608	− 4,518	− 989	− 13,126	− 17,806	− 5,507	− 22,324
8%	− 7,146	− 3,751	− 821	− 10,897	− 14,783	− 4,572	− 18,534
10%	− 6,079	− 3,191	− 699	− 9,270	− 12,575	− 3,890	− 15,766
12%	− 5,279	− 2,771	− 607	− 8,050	− 10,921	− 3,378	− 13,692

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15. Housing

15.1. General Implications of Relocation

15.1.1 Depopulation of Areas B, C and D would impose a cost on society in that properties which have value in use would be abandoned. The loss resulting from the abandonment of properties of a commercial or business nature can be approximated, as a general rule, by the present value equivalent of the net future stream of income that would have accrued from such properties if they remained in their present use. Particular adjustments have to be made in respect of properties used for farming, the only significant commercial activity in Areas B, C and D, but these are discussed at length elsewhere.[1]

15.1.2 We are presently concerned, therefore, only with the loss brought about by the abandonment of properties of a domestic or residential nature. This loss can, subject to the reservations expressed in Appendix IV, be represented by the market value of those properties which is, roughly, the present value equivalent of the future stream of utility that would have been derived from their occupation but which is now foregone as a result of depopulation. Abandonment of properties is therefore a loss in *real* terms, for to make it possible for individuals to acquire a stream of utility of similar present worth, resources of an equivalent value would have to be given up.

15.1.3 Rehousing the displaced population would then involve the additional cost of constructing the necessary residential properties. This cost could, however, be offset to a greater or lesser degree by the present worth of the benefits provided by those properties, which can similarly be approximated by their market value.

15.1.4 Estimation of the above-mentioned costs and benefits is the subject of the present chapter. We first show more precisely what information is required, in particular on what basis valuations should be made, and what assumptions have to be made concerning the new houses that would have to be built to accommodate the displaced families.

15.2. Information Requirements

The Cost of the Water Supply Scheme

15.2.1 If the planned water supply scheme went ahead, certain costs would be incurred in maintaining the existing settlement pattern. First, there would be costs, the nature of which have already been discussed; these include not only the initial outlay and recurrent expenditure on the water supply scheme itself and on other utilities, but also on private transportation of one form or another, and on health, educational and welfare services. As an offset to this expenditure there would be the net value of the agricultural output produced in the area if the water supply scheme proceeded. We refer to the net present worth of such

[1] See Chapter 7.

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costs—the costs of maintaining the existing settlement pattern, less the value of agricultural output, *but excluding housing implications*—as W_1.

15.2.2 The first consequence, for honsing, of the water supply scheme would be the benefit of the increase in value of the properties connected to the scheme. Since the present study requires, for logical consistency, both that all properties should be assumed to connect to the mains, and that all acquire adequate means of sewage disposal, a benefit of the water supply scheme and its consequences can be designated as $(V_1 - V_0)$ where

V_0 = the market value of properties as they are currently (i.e. no mains water supply or, where applicable, adequate sewage disposal facilities), and

V_1 = the market value of properties when mains water is supplied and adequate sewage disposal facilities exist.

15.2.3 The effect of the water supply scheme on the value of existing properties does not stop here, for if existing properties in Areas B, C and D continue to be inhabited there is no doubt that certain improvements would be made to them by their owners. This would be encouraged by the improvement in facilities (in particular, water supply, sewerage and electricity) of the kind postulated on previous pages. Such encouragement would be reinforced, should current official policy be maintained, by the opportunity given to householders to obtain financial assistance from their local authority towards the improvement of older properties. This is particularly likely to be an important influence in the present context since Standard and Discretionary Grants are both largely designed to encourage the improvement of domestic water-using and disposal facilities (i.e. bathrooms and water closets). A further consequence of the water supply scheme, therefore, is that over a period of time, additional expenditure would probably be incurred in improving existing properties. We refer to the present worth of the cost of internal property improvements as X_1.

15.2.4 On the other hand, as an offset to the cost of internal improvements, there would be a benefit, which can be approximated, by parallel reasoning to that outlined above, by the increase in the market value of the properties concerned. This benefit can be approximated by $V_2 - V_1$ where

V_2 = the market value of properties with water supply and sewerage, but without internal improvements (i.e. V_1), *plus* the present worth of the increase in market values resulting from improvements.

Conceivably X_1 could be equal to, greater or less than $V_2 - V_1$.

The net cost of supplying water to the area and maintaining the population therein is therefore:—

$$W_1 + X_1 - (V_1 - V_0) - (V_2 - V_1), \text{ or}$$
$$W_1 + X_1 + V_0 - V_2. \qquad (15.1)$$

The Cost of Rehousing

15.2.5 As stated, depopulation of Areas B, C and D would involve a cost in terms of the value of the abandoned properties. Since depopulation would only

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take place if the water supply scheme did not go through, the appropriate market value to estimate would in fact be V_0.

15.2.6 The next thing to consider is the present worth of the cost of providing services of various sorts (i.e. water supply, etc., *less* the value of agricultural output associated with the new settlement pattern) for the relocation sites. This is referred to as W_2, which is defined in a similar way to W_1 and covers the same sectors of activity. Finally, the cost (Y) of constructing properties in the relocation sites will be offset to a greater or lesser extent by their value (V_3).

15.2.7 The cost of rehousing is therefore:—

$$V_0 + W_2 + Y - V_3 \qquad (15.2)$$

The Net Cost of Relocation

15.2.8 In determining the net cost or benefit of relocation, therefore, the test that should be made is whether

$$W_1 + X_1 + V_0 - V_2 \gtreqless V_0 + W_2 + Y - V_3, \text{ or}$$

$$W_1 + X_1 - V_2 \gtreqless W_2 + Y - V_3 \qquad (15.3)$$

15.2.9 Subject to reservations regarding the price that properties fetch in the market as being an adequate measure of benefit (or of cost in the case of abandoned properties), the costs and values in expression (15.3) are the ones that ought, ideally, to be estimated in an exercise of this sort.

15.2.10 It may be argued that the replacement of existing properties by new ones is itself a point in favour of relocation. Indeed, some properties now in Areas B, C and D may shortly, because of age or inadequate maintenance, be due for demolition. It is not, however, necessary to estimate the future useful lives of existing properties, as these will be reflected in V_0, V_1 or V_2 as the case may be. The same applies to the expected lives of the newly built houses at the relocation sites, which will partly determine the magnitude of V_3.

15.3. Some Problems of Estimation

Costs and Benefits of House Improvements

15.3.1 In order accurately to estimate the present worth of the costs and benefits of house improvements it would be necessary to know, not only by what margin a given expenditure increases the value of properties, but also the time pattern of such expenditure, following the introduction of the water supply scheme.

15.3.2 A study which was undertaken by the Ministry of Housing and Local Government elsewhere in the W.S.W.B's area of supply, concerning the relationship between the cost of house improvements and the consequent increase in property values, yielded insufficient results for reliable conclusions to be drawn. Consequently, and in the absence of any better information, it was assumed that expenditure on improvements would yield an addition to property values of an equal magnitude, i.e. $X_1 = V_2 - V_1$.

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15.3.3 The major difficulty associated with this assumption is due to the fact that improvements are grant-aided; there is certainly no reason, *a priori*, why the grant element of the improvement expenditure should be matched by an equivalent increase in property value. To take an extreme example to illustrate this, suppose that an unlimited grant is allowed for house improvements, to which the householder is required to contribute nothing. The effective cost to him at the margin would therefore be zero, and he would take advantage of the grant up to the point that the marginal value to him of the improvement was also zero.

15.3.4 In practice, of course, improvement grants are subject to certain restrictions. In the case of Standard Grants, half of the cost only of approved improvement works, subject to an upper limit, is met by the local authority, while for Discretionary Grants, *up to* one-half of the cost, again subject to a maximum,[1] may be allowed. Roughly, therefore, one can say that, up to a certain amount, this policy encourages a householder, subject to his being able to obtain the necessary funds, to commit himself and the local authority to expenditure on improvements as long as the benefit to him, at the margin, is *half* of the marginal cost of improvement; i.e. at the margin, for grant-aided expenditure,

$$V_2 - V_1 = X_1 - G$$

where G = Grant paid on marginal improvement.

Alternatively, since $X_1 = 2G$,

$$V_2 - V_1 = \frac{X_1}{2} = G$$

15.3.5 This does not however mean that the value of improvements should be estimated simply by deducting the grant element from the total cost. Had the study mentioned above been successful, it may in fact have shown that for some households $V_2 - V_1 > X_1$ and that the equality $V_2 - V_1 = \frac{X_1}{2}$ is very strictly a minimum estimate of the value of a given expenditure on improvements. On the other hand, one good reason why grants may be considered necessary may of course be that improvement costs are *not* matched by an equivalent increase in property values; i.e. for some properties $X_1 > V_2 - V_1 > \frac{X_1}{2}$,

15.3.6 There are therefore two influences, pulling in opposite directions, that have to be considered. First, as we have noted, for some householders the contribution towards improvement costs will only be a minimum estimate of the value they derive from such improvements. The excess of the maximum amount they would be willing to pay for a given improvement over what they actually do pay is known as 'consumers' surplus'. Moreover, this surplus would also be gained on non grant-aided expenditures, which to judge from past data provided by Atcham R.D.C., are likely to be considerably greater than those

[1] The maximum is in the process of revision, but the principle remains unchanged: see White Paper, *Old Houses into New Homes*, Ministry of Housing and Local Government, Cmd. 3602, H.M.S.O., 1968.

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which do qualify for grants.[1] This suggests that, *in total*, $V_2 - V_1 > X_1$. On the other hand, householders in receipt of grants may use local authority funds for improvements which they would not pay for if they had to (directly) themselves, which implies that, *at the margin*, $X_1 > V_2 - V_1$. The assumption that $X_1 = V_2 - V_1$ is therefore a compromise; its theoretical justification does, however, raise issues of a more general character, these being discussed in Appendix IV.

15.3.7 Because of the assumption that $X_1 = V_2 - V_1$, it was unnecessary to estimate the likely reaction of individuals to the water supply scheme in terms of carrying out improvements. On the other hand, should experience elsewhere indicate that X_1 was likely to be significantly greater or less than $V_2 - V_1$, the time pattern of the improvement expenditure would have to be estimated. Past data from other areas would be an unsatisfactory guide however, for even if different circumstances of other areas could be isolated, the publicity currently being given to the grant scheme is likely to encourage a faster rate of improvement in the future.

15.3.8 The question of reactions has been avoided to some extent by the assumption, necessary to the logic of the present exercise, that two kinds of improvements take place at t_0 should the water supply scheme go ahead. These are connections to the water mains and, for some properties, improvement of sewage disposal facilities, both of which, up to a certain limit, qualify for grant aid. As we shall show below, valuation of existing properties was made on this basis (i.e. V_1).

15.3.9 In conclusion, substituting $V_2 - V_1$ for X_1 in expression (15.1), the cost of the planned water supply scheme can be shown as

$$W_1 - V_1 + V_0 \qquad (15.4)$$

New Properties: Costs and Values

15.3.10 The cost of replacement housing as estimated by the Atcham R.D.C. is as follows:—

TABLE 15.1

2 bedroom house	£3,500
3 ,, ,,	£3,800
4 ,, ,,	£4,000

15.3.11 These figures refer to semi-detached properties, the construction of which is normal in rural areas, and are based on the costs of developing estates

[1] Although past data is for several reasons an inadequate guide to future events, Atcham R.D. experience is instructive. Thus, between April 1960 and September 1967 Standard Grants (which form the bulk of all grants) formed 31% only of the total expenditure on grant-aided improvements, the average grant per property concerned being £120. Since the type of improvement qualifying for grants is very limited, the total figure must exclude a considerable proportion of home improvement expenditure. Surpluses resulting from all this expenditure (the extent of which is not known) should, theoretically, be a positive figure to offset against costs.

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of 20 houses or more. They can therefore be applied to all the possible relocation solutions. The costs include £250 each for garage accommodation (which is now a planning requirement) as well as the cost of land, road and site works; services are allowed for, together with internal site drainage up to but excluding the sewer itself, the cost of which has been estimated separately and appears in the section dealing specifically with sewerage.

15.3.12 The inclusion of all services requires that a slight adjustment be made to the above figures, for the cost of supplying electricity and water to individual properties (roughly £55) has already been taken into account under the appropriate headings. Adjusting for this, and assuming the service cost per property to be the same irrespective of the size of house, the costs will therefore be:—

TABLE 15.2

2 bedroom house	£3,445
3 „ „	£3,745
4 „ „	£3,945

15.3.13 To allow a sensible cost comparison to be made of pre- and post-relocation conditions, we have been concerned throughout this study to estimate the cost of providing the same amenities or standards of service in both circumstances. In the case of housing, attainment of this ideal is an impossible task, but we have attempted to go some way towards it; hence the concern with the number of rooms and, to a lesser extent, with garages.

15.3.14 The inclusion of garages with the new houses is largely justified by the fact that in a rural area nearly all properties in effect have garages, even though they may not be officially designated (for rating purposes) as such. The question of numbers of rooms was more difficult; it was necessary to discover the number of rooms *used for domestic purposes* in each house in Areas B, C and D, and to use this as a guide to the size of properties required for rehousing. Problems arose because a number of properties could not be absorbed into the two-, three- and four-bedroom classification of houses. Thus, one property had 30 rooms, while several had ten or more: at the other extreme, several had only three rooms altogether.

15.3.15 We did not consider the possibility that new homes of equal size to those vacated would be built, but retained the 'normal' classification of properties built by local authorities. It was in fact envisaged that new properties would replace old on the following basis:—

TABLE 15.3

Number of Bedrooms (New Properties)	Number of Rooms (Existing Properties)
2	$\leqslant 6$
3	7–9
4	$\geqslant 10$

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15.3.16 Relocation would therefore demand the construction of the following properties at t_0:—

TABLE 15.4

	2 bedroom	3 bedroom	4 bedroom
Area B[1]			
Acton Burnell ...	28	6	6
Leebotwood ...	34	8	8
Longnor	26	6	6
Area C			
Leebotwood ...	31	18	7
Area D			
Acton Burnell ...	46	24	11

15.3.17 The cost of new housing would therefore be:—

TABLE 15.5
Cost of New Housing (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0	456,960	201,820	291,745	658,780	748,705	493,565	950,525

15.3.18 With one slight reservation, the above is only of interest in terms of its budgetary significance for the exercise. The reason for this is that, upon the advice of the local valuer, the cost of the new properties had to be accepted as a measure of the price that similar properties would fetch in the market if offered (individually) for sale (i.e. $Y = V_3$). The implications of this are explained as follows.

15.3.19 First, the Atcham R.D.C. invite tenders from builders for the construction of their houses, and it is reasonable to assume that the builder will obtain a profit therefrom at least equal to that obtained should he build similar houses for private sale. On the other hand, the tendering procedure may facilitate a degree of competition and the restriction of abnormally high profits. The implication of assuming that $Y = V_3$ is therefore that competition between builders, and competition between local authority and private housing, tends to keep prices paid by local authorities for houses in line with the price they would fetch on the open market. Clearly, this is a very rough approximation, but in the absence of any clear indication of divergence between cost and market value, it has to suffice. (This, too, is part of a wider issue, discussed in Appendix IV.)

15.3.20 Certain important consequences followed from this. First of all the original intention was to select, for valuation, properties of the sort that would be built in the relocation villages; these properties would ideally have been

[1] These are allocated on a *pro rata* basis between the relocation villages in Area B.

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located in areas either close to the planned relocation sites, or in comparable positions regarding communications, distance from Shrewsbury, etc. The idea of this was that by selecting such properties, double-counting of the travel benefits or costs of relocation would be avoided. In the event, no such fine calculation was possible, and identification of existing newly-built properties became irrelevant.

15.3.21 A second consequence was that it now became immaterial to the result of the social cost-benefit calculation whether or not properties of an equivalent nature to those abandoned were deemed to be built to rehouse the displaced population; a cost of £x would simply be offset by a benefit of £x.[1] A similar conclusion would have resulted from evidence suggesting that, for example, $V_3 > Y$ by the same absolute amount for all properties, whatever the size of Y. If on the other hand the absolute margin varied according to Y, selection of the size of the new properties would be a crucial determinant of the feasibility of the rehousing solution.

15.3.22 Despite the above, we cannot leave the subject of the costs and benefits of rehousing yet, for one small point remains. This is that $V_3 = Y = E + Z$, where

E = the cost of individual connection to electricity and water supply services, and

Z = all other housing costs.

(Thus, for a two-bedroom house, E and Z are, respectively, £55 and £3,445.)

15.3.23 The importance of this is that the cost of connecting new properties has already been estimated in the sections dealing with electricity and water supply. Since $V_3 = E + Z$, E could have been deleted and V_3 and Z ignored, but this was not done because identification of E was useful for comparing the cost of meeting the requirements of the pre- and post-relocation situations in respect of electricity and water supply. Having already included part of the total cost of constructing new properties in the calculation, it must therefore be offset by a benefit of equal magnitude, of £55 per property. This is an academic point, for the costs are small, but for the sake of logical completeness and to avoid double-counting, the costs of connection to electricity and water supply shown in Table 15.6 should be deducted from those in Table 15.5.

TABLE 15.6

Cost of Connection to Electricity and Water Supply: New Housing (£)

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0	7,040	3,080	4,455	10,120	11,495	7,535	14,575

[1] But as we have noted, rather obliquely, and in terms of budgetary implication, distributional considerations are important; thus, the cost *to any one individual* may not be offset by an equal benefit to him.

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15.3.24 In conclusion, having made this slight adjustment, if $V_3 = Y$, expression (15.2) now becomes

$$V_0 + W_2 \tag{15.5}$$

and the net cost of relocation is determined by the test

$$W_1 - V_1 + V_0 \gtrless V_0 + W_2, \text{ or}$$

$$W_1 - V_1 \gtrless W_2 \tag{15.6}$$

15.3.25 The estimation of W_1 and W_2 has been the subject of the preceding sections. The final estimate to be made is therefore the cost of abandoning properties in Areas B, C and D, this being represented by V_1.

Valuation of Existing Properties

15.3.26 Estimation of V_1 required that a valuation[1] of a sample of existing properties be made on the basis that they received mains water supply and had adequate sewage disposal facilities. This work was carried out by the District Valuer.

15.3.27 One difficulty of valuation was that, in the case of farm properties, it had to be restricted to the residential parts only, the reason for this being that the effect of depopulation on farm output had been dealt with under a separate heading. Consequently, the value of 'productive' parts of farm buildings, if the latter were to be abandoned, would be reflected in the fall in value of net output accruing from their use.

15.3.28 The largest sample that could reasonably be obtained would cover roughly one-third of the total properties in Areas B, C and D. A pilot sample was not a practicable proposition in the time available but, prior to the sample being valued, there was, with the exception of two properties, no apparent reason to distinguish between B, C and D in terms of the homogeneity of properties in each. The sample was therefore simply allocated in proportion to the number of properties in each area, one-third of each being valued. Confidence limits were thus defined after the event.

15.3.29 The exceptions to the homogeneity assumption were provided by two outstanding properties in Area B. As these were obviously so much more valuable than the remainder they were valued separately, the rest being selected for valuation at random.

15.3.30 For Area B, therefore, the total value of properties was estimated as $P + 126\bar{X}_B$, where

P = the value of the two outstanding properties, and

$\bar{X}_B$ = the sample mean.

For C and D, the estimates were $56\bar{X}_C$ and $81\bar{X}_D$ respectively.

[1] Rateable values were not considered to be a useful guide for this purpose.

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Private Travel Costs and Property Values

15.3.31 Having arrived at the estimated market value of properties in Areas B, C and D, it was then necessary to allow for the fact that the market value of any property is partly determined by the costs associated with its occupancy. In this context the relevant item to consider is the cost of travelling that is involved; for the purpose of the present exercise this is defined as the *difference* between the travel costs privately incurred by occupiers (i.e. inclusive of such items as petrol tax) should existing properties remain occupied, and those incurred should relocation take place. In the terms employed in Chapter 13, it is clear that only *existing* types of journey need be considered as being determinants of property values.

15.3.32 If no allowance is made for this, it means that to use market values of properties as a measure of the cost of relocation, and at the same time to include the travel savings that would result, is to underestimate the real cost of relocation, for certain 'benefits' would be counted twice. This does not, however, imply that travel savings on existing types of journey should be ignored altogether: this could be done if social costs of travel were identical to private costs; but of course they are not. Rather, the social cost of relocation should be estimated by taking the market value of abandoned properties, subtracting[1] from this the travel savings (in social terms) made possible by relocation, and then adding[2] to this the travel savings privately obtained by individuals should relocation take place.

15.3.33 The problem can be formulated in the following way:—

$$V_1 = G - K$$

where V_1 = market value of existing properties,
G = gross value of existing properties, and
K = present worth of the costs associated with the occupancy of those properties, here defined as travel costs privately incurred.

but $S = G - K'$

where S = social cost of abandoning properties, and
K' = present worth of the social costs of travel.

15.3.34 So far, we have used $V_1 - K'$ as being the net social cost of abandonment, where K' is estimated as the social costs of travel on existing types of journey *relative to those incurred in the relocation situation.* (In each of B, C and D, K' is positive, so that relocation would allow savings on this account.) $V_1 - K'$ is, however, an inadequate measure of the social cost of relocation, for it is necessary to estimate $G - K'$.

$$\begin{aligned} \text{But } (G - K') - (V_1 - K') \\ = G - V_1 \\ = K \end{aligned}$$

15.3.35 In order to estimate the net cost of relocation, K can be taken to represent the difference between the private travel costs incurred before and

[1] Or adding additional social travel costs.
[2] Or subtracting additional private travel costs.

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after relocation. If K is positive, as it is in the present exercise, it should therefore be counted as a further cost of relocation, so as far as existing properties and existing types of journey are concerned, the cost of relocation is estimated as

$$V_1 - K' + K$$

15.3.36 Since travel by bus in the study area is of negligible importance, the data on changes in vehicle mileage on existing types of journey listed in Tables 13.3, 13.7 and 13.11 were used to calculate the savings in private travel costs (i.e. inclusive of the relevant taxes) resulting from relocation. Motor car running costs privately incurred were calculated from data published by the Automobile Association,[1] with adjustments in the light of subsequent budgetary changes. These were estimated as follows:—

TABLE 15.7

Private Cars: Marginal Operating Costs per Mile (at Market Prices)

Vehicle Size (c.c.)	Cost (pence)
⩽1,000	5·1
1,001—1,500	5·9
1,501—2,000	7·7
2,001—2,500	9·3

15.3.37 The same general procedure was employed as that outlined in Chapter 13 regarding the breakdown into vehicle size groups for the various areas, but no estimates were made of the extent to which marginal (private) operating costs vary with speed. However, the same assumptions were made concerning the value of N.W.T., and where N.W.T. was equated to ¾ W.T., the same basis was used to calculate the mileage covered on classified and unclassified roads. Where N.W.T. = ¾ W.T., the formula $\frac{3(1\cdot1)}{4}$ M continued to be used in the calculation of employed persons' travelling time,[2] and the same proportions of farmers' and non-farmers' travelling time were also used. The re-employment time lag was not a relevant consideration in this context. On this basis the value of K is shown as follows:—

TABLE 15.8(A)

Net Travel Costs Privately Incurred (£)

N.W.T. = 0

	Area Relocated						
Year	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	1,471	50	1,330	1,521	2,801	1,380	2,851

[1] *Schedule of Estimated Running Costs*, Tech. 9, Automobile Association, January 1967.
[2] See paragraph 13.4.9.

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TABLE 15.8(B)

Net Travel Costs Privately Incurred (£)

N.W.T. = ¾ W.T.

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0–t_{30}	1,796	121	1,549	1,917	3,345	1,670	3,466

15.4. Results

Area B

15.4.1 In this area the total value of the two exceptional properties was estimated at £40,000, the sample mean of the remainder being £2,850. On this basis the total value of abandoned domestic properties was estimated as

$$P + 126\,\bar{X}_B = £40{,}000 + 126\,(2{,}850) = £399{,}100.$$

95% confidence limits for the population, μ, are determined by the formula

$$\bar{X} = \pm 1{\cdot}96 \frac{S}{\sqrt{N}} \sqrt{1-F}$$

where S = standard deviation of the sample ($S_B = £1{,}615$)

N = sample size ($N_B = 43$)

F = sampling fraction (the ratio of the size of the sample to the size of the population) ($F_B \simeq \frac{1}{3}$).

15.4.2 The figure of £40,000, representing the value of the two outstanding properties, was set aside, for we were concerned only with the range within which it could be confidently predicted that the mean of the population of the 126 *remaining* properties would lie. 95% confidence limits for the remainder were in fact $\bar{X}_B \pm £394$.

Area C

$$\bar{X}_C = £2{,}474$$

$$S_C = £807$$

$$N_C = £19$$

$$F_C \simeq \tfrac{1}{3}$$

$$56\,\bar{X}_C = £138{,}544$$

95% confidence limits = $\bar{X}_C \pm £296$.

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Area D

$$\bar{X}_D = £2,843$$
$$S_D = £1,665$$
$$N_D = 27$$
$$F_D = \tfrac{1}{3}$$
$$81\,\bar{X}_D = £230,283$$

95% confidence limits $= \bar{X}_D \pm £512$.

15.4.3 Table 15.9 now presents three sets of estimates of the cost of abandoning existing properties. In view of the extent of the range within which we may be 95% confident that the population mean lies, the two extremes (1) and (3) are used as alternative estimates of the cost of relocation in the final calculation.

TABLE 15.9

Cost of Abandoning Existing Properties (Unadjusted) (£)

	(1)	(2)	(3)
Area B	399,100	349,456	448,744
Area C	138,544	121,968	155,120
Area D	230,283	188,811	271,755

15.4.4 Column (1) refers to the case in which $\bar{X}$ = the relevant μ, while (2) and (3) assume, respectively, that $\bar{X} > \mu$ and $\bar{X} < \mu$, both estimates of μ being calculated at the extremes of the 95% confidence limits. Should the point within the postulated range turn out to be an important determinant of the feasibility of relocation, further valuation of properties would be required. Given that there are practical limits to the size of the initial sample, and in view of the quantitative importance of the cost of abandoning properties, this would seem to be a likely eventuality in other studies of this sort that might be carried out.[1]

15.4.5 To the costs listed in Table 15.9 has to be added (K — E), K and E being as previously defined.[2] K varies according to the two assumptions concerning the value of N.W.T. and is given as a recurring cost over the period t_0 to t_{30}, while E is the same in all cases and applies at t_0 only. It is also convenient to include under the present heading the cost of removing household effects from existing dwellings to the relocation sites. This is estimated at £15 per house, which expenditure would be incurred at t_0 for the properties concerned.

15.4.6 The net cost of relocation on the housing account is therefore estimated as follows:—

[1] This certainly applies to the present one. (See Chapter 16, Tables 16.33 to 16.36.)
[2] See paragraphs 15.3.22 and 15.3.33.

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TABLE 15.10(A)

Net Cost of Relocation: Housing (£)

Summary

$\bar{X} < \mu$: N.W.T. = ¾ W.T.

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0	445,420	153,001	270,064	598,421	715,484	423,065	868,485
t_1–t_{30}	1,796	121	1,549	1,917	3,345	1,670	3,466

Present Worth Equivalent (£)

Discount Rate	B	C	D	B + C	B + D	C + D	B+C+D
6%	470,133	154,666	291,378	624,799	761,511	446,044	916,177
8%	465,643	154,363	287,506	620,006	753,149	441,869	907,512
10%	462,356	154,142	284,671	616,498	747,027	438,813	901,169
12%	459,896	153,976	282,549	613,872	742,445	436,525	896,421

TABLE 15.10(B)

$\bar{X} < \mu$: N.W.T. = 0 (£)

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0	445,095	152,930	269,845	598,025	714,940	422,775	867,870
t_1–t_{30}	1,471	50	1,330	1,521	2,801	1,380	2,851

Present Worth Equivalent (£)

Discount Rate	B	C	D	B + C	B + D	C + D	B+C+D
6%	465,336	153,618	288,146	618,954	753,482	441,764	907,100
8%	461,658	153,493	284,821	615,151	746,479	438,314	899,972
10%	458,967	153,382	282,387	612,349	741,354	435,769	894,736
12%	456,951	153,333	280,565	610,284	737,516	433,898	890,849

TABLE 15.10(C)

$\bar{X} = \mu$: N.W.T. = ¾ W.T. (£)

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0	395,776	136,425	228,592	532,201	624,368	365,017	760,793
t_1–t_{30}	1,796	121	1,549	1,917	3,345	1,670	3,466

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TABLE 15.10(D)

$\bar{X} = \mu$: N.W.T. = 0 (£)

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0	395,451	136,354	228,373	531,805	623,824	364,727	760,178
t_1–t_{30}	1,471	50	1,330	1,521	2,801	1,380	2,851

TABLE 15.10(E)

$\bar{X} > \mu$: N.W.T. = ¾ W.T. (£)

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B+C+D
t_0	346,132	119,849	187,120	465,981	533,252	306,969	653,101
t_1–t_{30}	1,796	121	1,549	1,917	3,345	1,670	3,466

Present Worth Equivalent (£)

Discount Rate	B	C	D	B + C	B + D	C + D	B+C+D
6%	370,845	121,514	208,434	492,359	579,279	329,948	700,793
8%	366,355	121,211	204,562	487,566	570,917	325,773	692,128
10%	363,068	120,990	201,727	484,058	564,795	322,717	685,785
12%	360,608	120,824	199,605	481,432	560,213	320,429	681,037

TABLE 15.10(F)

$\bar{X} > \mu$: N.W.T. = 0 (£)

Year	*Area Relocated*						
	B	C	D	B + C	B + D	C+ D	B+C+D
t_0	345,807	119,778	186,901	465,585	532,708	306,679	652,486
t_1–t_{30}	1,471	50	1,330	1,521	2,801	1,380	2,851

Present Worth Equivalent (£)

Discount Rate	B	C	D	B + C	B + D	C + D	B+C+D
6%	366,048	120,466	205,202	486,514	571,250	325,668	691,716
8%	362,370	120,341	201,877	482,711	564,247	322,218	684,588
10%	359,679	120,230	199,443	479,909	559,122	319,673	679,352
12%	357,663	120,181	197,621	477,844	555,284	317,802	675,465

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16. The Net Benefits of Relocation

16.1. Alternative Solutions

16.1.1 The data listed in the preceding pages are now aggregated and the present worth of the cost of the various relocation alternatives estimated. Alternative solutions, based upon discount rates of 6%, 8%, 10% and 12%, are shown; at each rate of discount, solutions vary according to the different assumptions made about the period of redundancy, value of N.W.T. and the value of abandoned domestic properties.

16.1.2 Letting

R_1 = two-year re-employment lag,

R_2 = zero re-employment lag,

T_1 = value of N.W.T. taken as $\frac{3}{4}$ W.T.,

T_2 = value of N.W.T. taken as zero,

H_1 = maximum estimate of value of abandoned domestic properties, and

H_2 = minimum estimate of value of abandoned domestic properties,

a detailed breakdown of the present worth of the costs incurred in each of the individual sectors of activity is as shown in Tables 16.1–16.32. The second column of each of these tables lists the appropriate table in the text from which present values are calculated. It will be noted that entries under the following headings are affected by the alternative assumptions specified

Agriculture (R_1, R_2)

Travel to Work, etc. (R_1, R_2, T_1, T_2)

Housing (H_1, H_2, T_1, T_2)

16.1.3 Tables 16.33–16.36 then summarise the aggregate net benefits accruing from relocation for each rate of discount employed. These show that, at any given rate of discount, the combination of assumptions most favourable to relocation is R_2, T_2, H_2, the least favourable therefore being R_1, T_1, H_1. Of these, the directional effects of H_1 and H_2 are self-evident, while the disadvantages of R_2 in the case of travel are outweighed by the advantages of its agricultural implications. T_2 is favourable to relocation on both the housing and travel accounts.

16.1.4 The general pattern is that losses in terms of abandoned housing, and travel to work, shops, entertainment and market are more than offset by savings in the water supply, agriculture, sewage disposal, mail, telephone, school, electricity supply and miscellaneous transport sectors. Moreover, it can be said that in general, relocation would result in heavy initial costs, followed by annual savings over the remainder of the period. Consequently, of the rates of discount used, the one most favourable to relocation is 6%, the least favourable 12%.

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Relocation would involve net costs over the existing situation in the following circumstances:—

Area Relocated	*Assumptions*	*Rate of Discount*
C, D, C + D	R_1 T_1 H_1	10%
All possibilities	R_1 T_1 H_1	12%
C, D, C + D	R_1 T_2 H_1	12%
C, D, B + C, C + D	R_2 T_1 H_1	12%
C	R_2 T_2 H_1	12%

16.1.5 It is not surprising to find that in all cases economies of scale are derived from relocating the residents of more than one area; for example, the savings accruing from the relocation of B + C would exceed the savings that would result from independent relocation of B and of C. In the case of C + D, the difference between the two figures is slight and is explained wholly by economies of scale in the provision of mail services should inhabitants of both areas be relocated together. Otherwise, Areas C and D are completely separate as far as the provision of services is concerned, and this also applies to the relocation sites chosen for each.

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TABLE 16.1

Present Worth of Costs at 6% (£)

$R_1T_1H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	852,383	654,910	804,103	754,553	606,630	557,080	706,273	508,800
Agriculture (R_1)	7.27(A)	1,830,043	1,379,899	1,704,093	1,501,620	1,253,949	1,051,476	1,375,670	925,526
Sewage Disposal	8.3	352,642	318,150	335,293	328,971	301,801	295,455	311,622	282,059
G.P.O. Telephones	9.5	16,472	10,838	14,597	13,222	8,963	7,588	11,347	5,713
Electricity Supply	10.7	39,109	37,480	37,293	38,762	31,393	33,199	36,946	27,110
G.P.O. Mail	11.5	156,419	126,564	142,865	139,159	113,128	105,185	122,770	95,071
Schools	12.5	373,450	322,619	373,450	370,857	322,619	322,619	370,857	322,619
Travel to Work etc. (R_1T_1)	13.23(A)	—	110,925	7,213	107,104	118,138	158,689	114,317	165,902
Miscellaneous Transport	14.6	—	− 8,608	− 4,518	− 989	− 13,126	− 17,806	− 5,507	−22,324
Housing (T_1H_1)	15.10(A)	—	470,133	154,666	291,378	624,799	761,511	446,044	916,177
	TOTAL	3,620,518	3,422,910	3,569,055	3,544,637	3,368,294	3,274,996	3,490,339	3,226,653

TABLE 16.2

Present Worth of Costs at 6% (£)

$R_1T_2H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	852,383	654,910	804,103	754,553	606,630	557,080	706,273	508,800
Agriculture (R_1)	7.27(A)	1,830,043	1,379,899	1,704,093	1,501,620	1,253,949	1,051,476	1,375,670	925,526
Sewage Disposal	8.3	352,642	318,150	335,293	328,971	301,801	295,455	311,622	282,059
G.P.O. Telephones	9.5	16,472	10,838	14,597	13,222	8,963	7,588	11,347	5,713
Electricity Supply	10.7	39,109	37,480	37,293	38,762	31,393	33,199	36,946	27,110
G.P.O. Mail	11.5	156,419	126,564	142,865	139,159	113,128	105,185	122,770	95,071
Schools	12.5	373,450	322,619	373,450	370,857	322,619	322,619	370,857	322,619
Travel to Work etc. (R_1T_2)	13.23(B)	—	46,255	4,652	41,890	50,907	69,644	46,542	74,296
Miscellaneous Transport	14.6	—	− 8,608	− 4,518	− 989	− 13,126	− 17,806	− 5,507	− 22,324
Housing (T_2H_1)	15.10(B)	—	465,336	153,618	288,146	618,954	753,482	441,764	907,100
	TOTAL	3,620,518	3,353,443	3,565,446	3,476,191	3,295,218	3,177,922	3,418,284	3,125,970

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TABLE 16.3

Present Worth of Costs at 6% (£)

$R_1T_1H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	852,383	654,910	804,103	754,553	606,630	557,080	706,273	508,800
Agriculture (R_1)	7.27(A)	1,830,043	1,379,899	1,704,093	1,501,620	1,253,949	1,051,476	1,375,670	925,526
Sewage Disposal	8.3	352,642	318,150	335,293	328,971	301,801	295,455	311,622	282,059
G.P.O. Telephones	9.5	16,472	10,838	14,597	13,222	8,963	7,588	11,347	5,713
Electricity Supply	10.7	39,109	37,480	37,293	38,762	31,393	33,199	36,946	27,110
G.P.O. Mail	11.5	156,419	126,564	142,865	139,159	113,128	105,185	122,770	95,071
Schools	12.5	373,450	322,619	373,450	370,857	322,619	322,619	370,857	322,619
Travel to Work etc. (R_1T_1)	13.23(A)	—	110,925	7,213	107,104	118,138	158,689	114,317	165,902
Miscellaneous Transport	14.6	—	− 8,608	− 4,518	− 989	− 13,126	− 17,806	− 5,507	− 22,324
Housing (T_1H_2)	15.10(E)	—	370,845	121,514	208,434	492,359	579,359	329,948	700,793
	TOTAL	3,620,518	3,323,622	3,535,903	3,461,693	3,235,854	3,092,764	3,374,243	3,011,269

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TABLE 16.4

Present Worth of Costs at 6% (£)

$R_1T_2H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	852,383	654,910	804,103	754,553	606,630	557,080	706,273	508,800
Agriculture (R_1)	7.27(A)	1,830,043	1,379,899	1,704,093	1,501,620	1,253,949	1,051,476	1,375,670	925,526
Sewage Disposal	8.3	352,642	318,150	335,293	328,971	301,801	295,455	311,622	282,059
G.P.O. Telephones	9.5	16,472	10,838	14,597	13,222	8,963	7,588	11,347	5,713
Electricity Supply	10.7	39,109	37,480	37,293	38,762	31,393	33,199	36,946	27,110
G.P.O. Mail	11.5	156,419	126,564	142,865	139,159	113,128	105,185	122,770	95,071
Schools	12.5	373,450	322,619	373,450	370,857	322,619	322,619	370,857	322,619
Travel to Work etc. (R_1T_2)	13.23(B)	—	46,255	4,652	41,890	50,907	69,644	46,542	74,296
Miscellaneous Transport	14.6	—	− 8,608	− 4,518	− 989	− 13,126	− 17,806	− 5,507	− 22,324
Housing (T_2H_2)	15.10(F)	—	366,048	120,466	205,202	486,514	571,250	325,668	691,716
	TOTAL	3,620,518	3,254,155	3,532,294	3,393,247	3,162,778	2,995,690	3,302,188	2,910,586

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TABLE 16.5

Present Worth of Costs at 6% (£)

$R_2T_1H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	852,383	654,910	804,103	754,553	606,630	557,080	706,273	508,800
Agriculture (R_2)	7.27(B)	1,890,089	1,411,688	1,760,607	1,533,409	1,282,206	1,055,008	1,403,927	925,526
Sewage Disposal	8.3	352,642	318,150	335,293	328,971	301,801	295,455	311,622	282,059
G.P.O. Telephones	9.5	16,472	10,838	14,597	13,222	8,963	7,588	11,347	5,713
Electricity Supply	10.7	39,109	37,480	37,293	38,762	31,393	33,199	36,946	27,110
G.P.O. Mail	11.5	156,419	126,564	142,865	139,159	113,128	105,185	122,770	95,071
Schools	12.5	373,450	322,619	373,450	370,857	322,619	322,619	370,857	322,619
Travel to Work etc. (R_2T_1)	13.23(C)	—	114,325	7,752	110,368	122,077	165,353	118,120	173,105
Miscellaneous Transport	14.6	—	− 8,608	− 4,518	− 989	− 13,126	− 17,806	− 5,507	− 22,324
Housing (T_1H_1)	15.10(A)	—	470,133	154,666	291,378	624,799	761,511	446,044	916,177
	TOTAL	3,680,564	3,458,099	3,626,108	3,579,690	3,400,490	3,285,192	3,522,399	3,233,856

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TABLE 16.6

Present Worth of Costs at 6% (£)

$R_2T_2H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	852,383	654,910	804,103	754,553	606,630	557,080	706,273	508,800
Agriculture (R_2)	7.27(B)	1,890,089	1,411,688	1,760,607	1,533,409	1,282,206	1,055,008	1,403,927	925,526
Sewage Disposal	8.3	352,642	318,150	335,293	328,971	301,801	295,455	311,622	282,059
G.P.O. Telephones	9.5	16,472	10,838	14,597	13,222	8,963	7,588	11,347	5,713
Electricity Supply	10.7	39,109	37,480	37,293	38,762	31,393	33,199	36,946	27,110
G.P.O. Mail	11.5	156,419	126,564	142,865	139,159	113,128	105,185	122,770	95,071
Schools	12.5	373,450	322,619	373,450	370,857	322,619	322,619	370,857	322,619
Travel to Work etc. (R_2T_2)	13.23(D)	—	48,075	4,917	43,542	52,992	73,116	48,459	78,033
Miscellaneous Transport	14.6	—	− 8,608	− 4,518	− 989	− 13,126	− 17,806	− 5,507	− 22,324
Housing (T_2H_1)	15.10(B)	—	465,336	153,618	288,146	618,954	753,482	441,764	907,100
	TOTAL	3,680,564	3,387,052	3,622,225	3,509,632	3,325,560	3,184,926	3,448,458	3,129,707

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TABLE 16.7

Present Worth of Costs at 6% (£)

$R_2T_1H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	852,383	654,910	804,103	754,553	606,630	557,080	706,273	508,800
Agriculture (R_2)	7.27(B)	1,890,089	1,411,688	1,760,607	1,533,409	1,282,206	1,055,008	1,403,927	925,526
Sewage Disposal	8.3	352,642	318,150	335,293	328,971	301,801	295,455	311,622	282,059
G.P.O. Telephones	9.5	16,472	10,838	14,597	13,222	8,963	7,588	11,347	5,713
Electricity Supply	10.7	39,109	37,480	37,293	38,762	31,393	33,199	36,946	27,110
G.P.O. Mail	11.5	156,419	126,564	142,865	139,159	113,128	105,185	122,770	95,071
Schools	12.5	373,450	322,619	373,450	370,857	322,619	322,619	370,857	322,619
Travel to Work etc. (R_2T_1)	13.23(C)	—	114,325	7,752	110,368	122,077	165,353	118,120	173,105
Miscellaneous Transport	14.6	—	− 8,608	− 4,518	− 989	− 13,126	− 17,806	− 5,507	− 22,324
Housing (T_1H_2)	15.10(E)	—	370,845	121,514	208,434	492,359	579,279	329,948	700,793
	TOTAL	3,680,564	3,358,811	3,592,956	3,496,746	3,268,050	3,102,960	3,406,303	3,018,472

TABLE 16.8

Present Worth of Costs at 6% (£)

$R_2T_2H_2$

Item	Table	Area Relocated							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	852,383	654,910	804,103	754,553	606,630	557,080	706,273	508,800
Agriculture (R_2)	7.27(B)	1,890,089	1,411,688	1,760,607	1,533,409	1,282,206	1,055,008	1,403,927	925,526
Sewage Disposal	8.3	352,642	318,150	335,293	328,971	301,801	295,455	311,622	282,059
G.P.O. Telephones	9.5	16,472	10,838	14,597	13,222	8,963	7,588	11,347	5,713
Electricity Supply	10.7	39,109	37,480	37,293	38,762	31,393	33,199	36,946	27,110
G.P.O. Mail	11.5	156,419	126,564	142,865	139,159	113,128	105,185	122,770	95,071
Schools	12.5	373,450	322,619	373,450	370,857	322,619	322,619	370,857	322,619
Travel to Work etc. (R_2T_2)	13.23(D)	—	48,075	4,917	43,542	52,992	73,116	48,459	78,033
Miscellaneous Transport	14.6	—	− 8,608	− 4,518	− 989	− 13,126	−17,806	− 5,507	− 22,324
Housing (T_2H_2)	15.10(F)	—	366,048	120,466	205,202	486,514	571,250	325,668	691,716
	TOTAL	3,680,564	3,287,764	3,589,073	3,426,688	3,193,120	3,002,694	3,332,362	2,914,323

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TABLE 16.9

Present Worth of Costs at 8% (£)

$R_1T_1H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	825,360	631,976	778,408	730,988	585,024	537,604	684,036	490,652
Agriculture (R_1)	7.27(A)	1,509,887	1,149,083	1,408,383	1,247,648	1,047,579	886,844	1,146,144	785,340
Sewage Disposal	8.3	335,230	304,659	319,707	313,949	290,135	284,103	298,426	272,031
G.P.O. Telephones	9.5	13,552	8,999	12,096	10,993	7,543	6,440	9,537	4,984
Electricity Supply	10.7	33,472	34,003	32,759	34,293	29,079	31,014	33,580	26,090
G.P.O. Mail	11.5	129,859	105,074	118,606	115,530	93,919	87,324	101,923	78,928
Schools	12.5	314,284	278,043	314,284	313,897	278,043	278,043	313,897	278,043
Travel to Work etc. (R_1T_1)	13.23(A)	—	91,531	5,900	88,381	97,431	130,649	94,281	136,549
Miscellaneous Transport	14.6	—	− 7,146	− 3,751	− 821	− 10,897	− 14,783	− 4,572	− 18,534
Housing (T_1H_1)	15.10(A)	—	465,643	154,363	287,506	620,006	753,149	441,869	907,512
	TOTAL	3,161,644	3,061,865	3,140,755	3,142,364	3,037,862	2,980,387	3,119,121	2,961,595

TABLE 16.10

Present Worth of Costs at 8% (£)

$R_1T_2H_1$

Item	Table	Area Relocated							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	825,360	631,976	778,408	730,988	585,024	537,604	684,036	490,652
Agriculture (R_1)	7.27(A)	1,509,887	1,149,083	1,408,383	1,247,648	1,047,579	886,844	1,146,144	785,340
Sewage Disposal	8.3	335,230	304,659	319,707	313,949	290,135	284,103	298,426	272,031
G.P.O. Telephones	9.5	13,552	8,999	12,096	10,993	7,543	6,440	9,537	4,984
Electricity Supply	10.7	33,472	34,003	32,759	34,293	29,079	31,014	33,580	26,090
G.P.O. Mail	11.5	129,859	105,074	118,606	115,530	93,919	87,324	101,923	78,928
Schools	12.5	314,284	278,043	314,284	313,897	278,043	278,043	313,897	278,043
Travel to Work etc. (R_1T_2)	13.23(B)	—	38,102	3,819	34,506	41,921	57,248	38,325	61,067
Miscellaneous Transport	14.6	—	− 7,146	− 3,751	− 821	− 10,897	− 14,783	− 4,572	− 18,534
Housing (T_2H_1)	15.10(B)	—	461,658	153,493	284,821	615,151	746,479	438,314	899,972
	TOTAL	3,161,644	3,004,451	3,137,804	3,085,804	2,977,497	2,900,316	3,059,610	2,878,573

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TABLE 16.11

Present Worth of Costs at 8% (£)

$R_1T_1H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	825,360	631,976	778,408	730,988	585,024	537,604	684,036	490,652
Agriculture (R_1)	7.27(A)	1,509,887	1,149,083	1,408,383	1,247,648	1,047,579	886,844	1,146,144	785,340
Sewage Disposal	8.3	335,230	304,659	319,707	313,949	290,135	284,103	298,426	272,031
G.P.O. Telephones	9.5	13,552	8,999	12,096	10,993	7,543	6,440	9,537	4,984
Electricity Supply	10.7	33,472	34,003	32,759	34,293	29,079	31,014	33,580	26,090
G.P.O. Mail	11.5	129,859	105,074	118,606	115,530	93,919	87,324	101,923	78,928
Schools	12.5	314,284	278,043	314,284	313,897	278,043	278,043	313,897	278,043
Travel to Work etc. (R_1T_1)	13.23(A)	—	91,531	5,900	88,381	97,431	130,649	94,281	136,549
Miscellaneous Transport	14.6	—	− 7,146	− 3,751	− 821	− 10,897	− 14,783	− 4,572	− 18,534
Housing (T_1H_2)	15.10(E)	—	366,355	121,211	204,562	487,566	570,917	325,773	692,128
	TOTAL	3,161,644	2,962,577	3,107,603	3,059,420	2,905,422	2,798,155	3,003,025	2,746,211

TABLE 16.12

Present Worth of Costs at 8% (£)

$R_1T_2H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	825,360	631,976	778,408	730,988	585,024	537,604	684,036	490,652
Agriculture (R_1)	7.27(A)	1,509,887	1,149,083	1,408,383	1,247,648	1,047,579	886,844	1,146,144	785,340
Sewage Disposal	8.3	335,230	304,659	319,707	313,949	290,135	284,103	298,426	272,031
G.P.O. Telephones	9.5	13,552	8,999	12,096	10,993	7,543	6,440	9,537	4,984
Electricity Supply	10.7	33,472	34,003	32,759	34,293	29,079	31,014	33,580	26,090
G.P.O. Mail	11.5	129,859	105,074	118,606	115,530	93,919	87,324	101,923	78,928
Schools	12.5	314,284	278,043	314,284	313,897	278,043	278,043	313,897	278,043
Travel to Work etc. (R_1T_2)	13.23(B)	—	38,102	3,819	34,506	41,921	57,248	38,325	61,067
Miscellaneous Transport	14.6	—	− 7,146	− 3,751	− 821	− 10,897	− 14,783	− 4,572	− 18,534
Housing (T_2H_2)	15.10(F)	—	362,370	120,341	201,877	482,711	564,247	322,218	684,588
	TOTAL	3,161,644	2,905,163	3,104,652	3,002,860	2,845,057	2,718,084	2,943,514	2,663,189

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TABLE 16.13

Present Worth of Costs at 8% (£)

$R_2T_1H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	825,360	631,976	778,408	730,988	585,024	537,604	654,036	490,652
Agriculture (R_2)	7.27(B)	1,569,575	1,180,683	1,464,560	1,279,248	1,075,668	890,356	1,174,233	785,340
Sewage Disposal	8.3	335,230	304,659	319,707	313,949	290,135	284,103	298,426	272,031
G.P.O. Telephones	9.5	13,552	8,999	12,096	10,993	7,543	6,440	9,537	4,984
Electricity Supply	10.7	33,472	34,003	32,759	34,293	29,079	31,014	33,580	26,090
G.P.O. Mail	11.5	129,859	105,074	118,606	115,530	93,919	87,324	101,923	78,928
Schools	12.5	314,284	278,043	314,284	313,897	278,043	278,043	313,897	278,043
Travel to Work etc. (R_2T_1)	13.23(C)	—	94,911	6,435	91,626	101,346	137,274	98,061	143,710
Miscellaneous Transport	14.6	—	− 7,146	− 3,751	− 821	− 10,897	− 14,783	− 4,572	− 18,534
Housing (T_1H_1)	15.10(A)	—	465,643	154,363	287,506	620,006	753,149	441,869	907,512
	TOTAL	3,221,332	3,096,845	3,197,467	3,177,209	3,069,866	2,990,524	3,150,990	2,968,756

TABLE 16.14

Present Worth of Costs at 8% (£)

$R_2T_2H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	825,360	631,976	778,408	730,988	585,024	537,604	684,036	490,652
Agriculture (R_2)	7.27(B)	1,569,575	1,180,683	1,464,560	1,279,248	1,075,668	890,356	1,174,233	785,340
Sewage Disposal	8.3	335,230	304,659	319,707	313,949	290,135	284,103	298,426	272,031
G.P.O. Telephones	9.5	13,552	8,999	12,096	10,993	7,543	6,440	9,537	4,984
Electricity Supply	10.7	33,472	34,003	32,759	34,293	29,079	31,014	33,580	26,090
G.P.O. Mail	11.5	129,859	105,074	118,606	115,530	93,919	87,324	101,923	78,928
Schools	12.5	314,284	278,043	314,284	313,897	278,043	278,043	313,897	278,043
Travel to Work etc. (R_2T_2)	13.23(D)	—	39,911	4,082	36,148	43,993	60,700	40,230	64,783
Miscellaneous Transport	14.6	—	− 7,146	− 3,751	− 821	− 10,897	− 14,783	− 4,572	− 18,534
Housing (T_2H_1)	15.10(B)	—	461,658	153,493	284,821	615,151	746,479	438,314	899,972
	TOTAL	3,221,332	3,037,860	3,194,244	3,119,046	3,007,658	2,907,280	3,089,604	2,882,289

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TABLE 16.15

Present Worth of Costs at 8% (£)

$R_2T_1H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	825,360	631,976	778,408	730,988	585,024	537,604	684,036	490,652
Agriculture (R_2)	7.27(B)	1,569,575	1,180,683	1,464,560	1,279,248	1,075,668	890,356	1,174,233	785,340
Sewage Disposal	8.3	335,230	304,659	319,707	313,949	290,135	284,103	298,426	272,031
G.P.O. Telephones	9.5	13,552	8,999	12,096	10,993	7,543	6,440	9,537	4,984
Electricity Supply	10.7	33,472	34,003	32,759	34,293	29,079	31,014	33,580	26,090
G.P.O. Mail	11.5	129,859	105,074	118,606	115,530	93,919	87,324	101,923	78,928
Schools	12.5	314,284	278,043	314,284	313,897	278,043	278,043	313,897	278,043
Travel to Work etc. (R_2T_1)	13.23(C)	—	94,911	6,435	91,626	101,346	137,274	98,061	143,710
Miscellaneous Transport	14.6	—	− 7,146	− 3,751	− 821	− 10,897	− 14,783	− 4,572	− 18,534
Housing (T_1H_2)	15.10(E)	—	366,355	121,211	204,562	487,566	570,917	325,773	692,128
	TOTAL	3,221,332	2,997,557	3,164,315	3,094,265	2,937,426	2,808,292	3,034,894	2,753,372

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TABLE 16.16

Present Worth of Costs at 8% (£)

$R_2T_2H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	825,360	631,976	778,408	730,988	585,024	537,604	684,036	490,652
Agriculture (R_2)	7.27(B)	1,569,575	1,180,683	1,464,560	1,279,248	1,075,668	890,356	1,174,233	785,340
Sewage Disposal	8.3	335,230	304,659	319,707	313,949	290,135	284,103	298,426	272,031
G.P.O. Telephones	9.5	13,552	8,999	12,096	10,993	7,543	6,440	9,537	4,984
Electricity Supply	10.7	33,472	34,003	32,759	34,293	29,079	31,014	33,580	26,090
G.P.O. Mail	11.5	129,859	105,074	118,606	115,530	93,919	87,324	101,923	78,928
Schools	12.5	314,284	278,043	314,284	313,897	278,043	278,043	313,897	278,043
Travel to Work etc. (R_2T_2)	13.23(D)	—	39,911	4,082	36,148	43,993	60,700	40,230	64,783
Miscellaneous Transport	14.6	—	− 7,146	− 3,751	− 821	− 10,897	− 14,783	− 4,572	− 18,534
Housing (T_2H_2)	15.10(F)	—	362,370	120,341	201,877	482,711	564,247	322,218	684,588
	TOTAL	3,221,332	2,938,572	3,161,092	3,036,102	2,875,218	2,725,048	2,973,508	2,666,905

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TABLE 16.17

Present Worth of Costs at 10% (£)

$R_1T_1H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	806,104	615,641	760,102	714,199	569,639	523,736	668,197	477,734
Agriculture (R_1)	7.27(A)	1,275,884	980,433	1,192,273	1,062,046	896,822	766,595	978,435	682,984
Sewage Disposal	8.3	322,515	294,807	308,324	302,978	281,616	275,813	288,787	264,708
G.P.O. Telephones	9.5	11,430	7,673	10,286	9,366	6,529	5,609	8,222	4,465
Electricity Supply	10.7	29,435	31,566	29,539	31,141	27,494	29,537	31,245	25,464
G.P.O. Mail	11.5	110,463	89,380	100,891	98,274	79,891	74,281	86,700	67,139
Schools	12.5	271,075	245,491	271,075	272,299	245,491	245,491	272,299	245,491
Travel to Work etc. (R_1T_1)	13.23(A)	—	77,375	4,942	74,716	82,317	110,185	79,658	115,127
Miscellaneous Transport	14.6	—	− 6,079	− 3,191	− 699	− 9,270	− 12,575	− 3,890	− 15,766
Housing (T_1H_1)	15.10(A)	—	462,356	154,142	284,671	616,498	747,027	438,813	901,169
	TOTAL	2,826,906	2,798,643	2,828,383	2,848,991	2,797,027	2,765,699	2,848,466	2,768,515

TABLE 16.18

Present Worth of Costs at 10% (£)

$R_1T_2H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	806,104	615,641	760,102	714,199	569,639	523,736	668,197	477,734
Agriculture (R_1)	7.27(A)	1,275,884	980,433	1,192,273	1,062,046	896,822	766,595	978,435	682,984
Sewage Disposal	8.3	322,515	294,807	308,324	302,978	281,616	275,813	288,787	264,708
G.P.O. Telephones	9.5	11,430	7,673	10,286	9,366	6,529	5,609	8,222	4,465
Electricity Supply	10.7	29,435	31,566	29,539	31,141	27,494	29,537	31,245	25,464
G.P.O. Mail	11.5	110,463	89,380	100,891	98,274	79,891	74,281	86,700	67,139
Schools	12.5	271,075	245,491	271,075	272,299	245,491	245,491	272,299	245,491
Travel to Work etc. (R_1T_2)	13.23(B)	—	32,151	3,210	29,116	35,360	48,203	32,326	51,413
Miscellaneous Transport	14.6	—	− 6,079	− 3,191	− 699	− 9,270	− 12,575	− 3,889	− 15,766
Housing (T_2H_1)	15.10(B)	—	458,967	153,382	282,387	612,349	741,354	435,769	894,736
	TOTAL	2,826,906	2,750,030	2,825,891	2,801,107	2,745,921	2,698,044	2,798,090	2,698,368

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TABLE 16.19

Present Worth of Costs at 10% (£)

$R_1T_1H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	806,104	615,641	760,102	714,199	569,639	523,736	668,197	477,734
Agriculture (R_1)	7.27(A)	1,275,884	980,433	1,192,273	1,062,046	896,822	766,595	978,435	682,984
Sewage Disposal	8.3	322,515	294,807	308,324	302,978	281,616	275,813	288,787	264,708
G.P.O. Telephones	9.5	11,430	7,673	10,286	9,366	6,529	5,609	8,222	4,465
Electricity Supply	10.7	29,435	31,566	29,539	31,141	27,494	29,537	31,245	25,464
G.P.O. Mail	11.5	110,463	89,380	100,891	98,274	79,891	74,281	86,700	67,139
Schools	12.5	271,075	245,491	271,075	272,299	245,491	245,491	272,299	245,491
Travel to Work etc. (R_1T_1)	13.23(A)	—	77,375	4,942	74,716	82,317	110,185	79,658	115,127
Miscellaneous Transport	14.6	—	− 6,079	− 3,191	− 699	− 9,270	− 12,575	− 3,889	− 15,766
Housing (T_1H_2)	15.10(E)	—	363,068	120,990	201,727	484,058	564,795	322,717	685,785
	TOTAL	2,826,906	2,699,355	2,795,231	2,766,047	2,664,587	2,583,467	2,732,370	2,553,131

TABLE 16.20

Present Worth of Costs at 10% (£)

$R_1T_2H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	806,104	615,641	760,102	714,199	569,639	523,736	668,197	477,734
Agriculture (R_1)	7.27(A)	1,275,884	980,433	1,192,273	1,062,046	896,822	766,595	978,435	682,984
Sewage Disposal	8.3	322,515	294,807	308,324	302,978	281,616	275,813	288,787	264,708
G.P.O. Telephones	9.5	11,430	7,673	10,286	9,366	6,529	5,609	8,222	4,465
Electricity Supply	10.7	29,435	31,566	29,539	31,141	27,494	29,537	31,245	25,464
G.P.O. Mail	11.5	110,463	89,380	100,891	98,274	79,891	74,281	86,700	67,139
Schools	12.5	271,075	245,491	271,075	272,299	245,491	245,491	272,299	245,491
Travel to Work etc. (R_1T_2)	13.23(B)	—	32,151	3,210	29,116	35,360	48,203	32,326	51,413
Miscellaneous Transport	14.6	—	− 6,079	− 3,191	− 699	− 9,270	− 12,575	− 3,890	− 15,766
Housing (T_2H_2)	15.10(F)	—	359,679	120,230	199,443	479,909	559,122	319,673	679,352
	TOTAL	2,826,906	2,650,742	2,792,739	2,718,163	2,613,481	2,515,812	2,681,994	2,482,984

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TABLE 16.21

Present Worth of Costs at 10% (£)

$R_2T_1H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	806,104	615,641	760,102	714,199	569,639	523,736	668,197	477,734
Agriculture (R_2)	7.27(B)	1,335,230	1,011,851	1,248,128	1,093,464	924,749	770,085	1,006,362	682,984
Sewage Disposal	8.3	322,515	294,807	308,324	302,978	281,616	275,813	288,787	264,708
G.P.O. Telephones	9.5	11,430	7,673	10,286	9,366	6,529	5,609	8,222	4,465
Electricity Supply	10.7	29,435	31,566	29,539	31,141	27,494	29,537	31,245	25,464
G.P.O. Mail	11.5	110,463	89,380	100,891	98,274	79,891	74,281	86,700	67,139
Schools	12.5	271,075	245,491	271,075	272,299	245,491	245,491	272,299	245,491
Travel to Work etc. (R_2T_1)	13.23(C)	—	80,736	5,474	77,942	86,210	116,772	83,416	122,245
Miscellaneous Transport	14.6	—	− 6,079	− 3,191	− 699	− 9,270	− 12,575	− 3,890	− 15,766
Housing (T_1H_1)	15.10(A)	—	462,356	154,142	284,671	616,498	747,027	438,813	901,169
	TOTAL	2,886,252	2,833,422	2,884,770	2,883,635	2,828,847	2,775,776	2,880,151	2,775,633

TABLE 16.22

Present Worth of Costs at 10% (£)

$R_2T_2H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	806,104	615,641	760,102	714,199	569,639	523,736	668,197	477,734
Agriculture (R_2)	7.27(B)	1,335,230	1,011,851	1,248,128	1,093,464	924,749	770,085	1,006,362	682,984
Sewage Disposal	8.3	322,515	294,807	308,324	302,978	281,616	275,813	288,787	264,708
G.P.O. Telephones	9.5	11,430	7,673	10,286	9,366	6,529	5,609	8,222	4,465
Electricity Supply	10.7	29,435	31,566	29,539	31,141	27,494	29,537	31,245	25,464
G.P.O. Mail	11.5	110,463	89,380	100,891	98,274	79,891	74,281	86,700	67,139
Schools	12.5	271,075	245,491	271,075	272,299	245,491	245,491	272,299	245,491
Travel to Work etc. (R_2T_2)	13.23(D)	—	33,950	3,472	30,749	37,422	51,635	34,221	55,106
Miscellaneous Transport	14.6	—	− 6,079	− 3,191	− 699	− 9,270	− 12,575	− 3,890	− 15,766
Housing (T_2H_1)	15.10(B)	—	458,967	153,382	282,387	612,349	741,354	435,769	894,736
	TOTAL	2,886,252	2,783,247	2,882,008	2,834,158	2,775,910	2,704,966	2,827,912	2,702,061

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TABLE 16.23

Present Worth of Costs at 10% (£)

$R_2T_1H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	806,104	615,641	760,102	714,199	569,639	523,736	668,197	477,734
Agriculture (R_2)	7.27(B)	1,335,230	1,011,851	1,248,128	1,093,464	924,749	770,085	1,006,362	682,984
Sewage Disposal	8.3	322,515	294,807	308,324	302,978	281,616	275,813	288,787	264,708
G.P.O. Telephones	9.5	11,430	7,673	10,286	9,366	6,529	5,609	8,222	4,465
Electricity Supply	10.7	29,435	31,566	29,539	31,141	27,494	29,537	31,245	25,464
G.P.O. Mail	11.5	110,463	89,380	100,891	98,274	79,891	74,281	86,700	67,139
Schools	12.5	271,075	245,491	271,075	272,299	245,491	245,491	272,299	245,491
Travel to Work etc. (R_2T_1)	13.23(C)	—	80,736	5,474	77,942	86,210	116,772	83,416	122,245
Miscellaneous Transport	14.6	—	− 6,079	− 3,191	− 699	− 9,270	− 12,575	− 3,890	− 15,766
Housing (T_1H_2)	15.10(E)	—	363,068	120,990	201,727	484,058	564,795	322,717	685,785
	TOTAL	2,886,252	2,734,134	2,851,618	2,800,691	2,696,407	2,593,544	2,764,055	2,560,249

TABLE 16.24

Present Worth of Costs at 10% (£)

$R_2T_2H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	806,104	615,641	760,102	714,199	569,639	523,736	668,197	477,734
Agriculture (R_2)	7.27(B)	1,335,230	1,011,851	1,248,128	1,093,464	924,749	770,085	1,006,362	682,984
Sewage Disposal	8.3	322,515	294,807	308,324	302,978	281,616	275,813	288,787	264,708
G.P.O. Telephones	9.5	11,430	7,673	10,286	9,366	6,529	5,609	8,222	4,465
Electricity Supply	10.7	29,435	31,566	29,539	31,141	27,494	29,537	31,245	25,464
G.P.O. Mail	11.5	110,463	89,380	100,891	98,274	79,891	74,281	86,700	67,139
Schools	12.5	271,075	245,491	271,075	272,299	245,491	245,491	272,299	245,491
Travel to Work etc. (R_2T_2)	13.23(D)	—	33,950	3,472	30,749	37,422	51,635	34,221	55,106
Miscellaneous Transport	14.6	—	− 6,079	− 3,191	− 699	− 9,270	− 12,575	− 3,890	− 15,766
Housing (T_2H_2)	15.10(F)	—	359,679	120,230	199,443	479,909	559,122	319, 673	679,352
	TOTAL	2,886,252	2,683,959	2,848,856	2,751,214	2,643,470	2,522,734	2,711,816	2,486,677

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TABLE 16.25

Present Worth of Costs at 12% (£)

$R_1T_1H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	792,025	603,700	746,719	701,926	558,404	513,601	656,630	468,305
Agriculture (R_1)	7.27(A)	1,100,690	854,130	1,030,470	923,054	783,910	676,494	852,834	606,274
Sewage Disposal	8.3	312,988	287,426	299,796	294,759	275,234	269,602	281,567	259,221
G.P.O. Telephones	9.5	9,845	6,694	8,943	8,145	5,792	4,994	7,243	4,092
Electricity Supply	10.7	26,467	29,810	27,188	28,856	26,377	28,510	29,577	25,077
G.P.O. Mail	11.5	95,931	77,621	87,618	85,345	69,381	64,509	75,294	58,306
Schools	12.5	238,702	221,101	238,702	241,134	221,101	221,101	241,134	221,101
Travel to Work etc. (R_1T_1)	13.23(A)	—	66,771	4,225	64,478	70,996	94,856	68,703	99,081
Miscellaneous Transport	14.6	—	− 5,279	− 2,771	− 607	− 8,050	− 10,921	− 3,378	− 13,692
Housing (T_1H_1)	15.10(A)	—	459,896	153,976	282,549	613,872	742,445	436,525	896,421
	TOTAL	2,576,648	2,601,870	2,594,866	2,629,639	2,617,017	2,605,191	2,646,129	2,624,186

TABLE 16.26

Present Worth of Costs at 12% (£)

$R_1T_2H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	792,025	603,700	746,719	701,926	558,404	513,601	656,630	468,305
Agriculture (R_1)	7.27(A)	1,100,690	854,130	1,030,470	923,054	783,910	676,494	852,834	606,274
Sewage Disposal	8.3	312,988	287,426	299,796	294,759	275,234	269,602	281,567	259,221
G.P.O. Telephones	9.5	9,845	6,694	8,943	8,145	5,792	4,994	7,243	4,092
Electricity Supply	10.7	26,467	29,810	27,188	28,856	26,377	28,510	29,577	25,077
G.P.O. Mail	11.5	95,931	77,621	87,618	85,345	69,381	64,509	75,294	58,306
Schools	12.5	238,702	221,101	238,702	241,134	221,101	221,101	241,134	221,101
Travel to Work etc. (R_1T_2)	13.23(B)	—	27,694	2,755	25,079	30,449	41,427	27,834	44,182
Miscellaneous Transport	14.6	—	− 5,279	− 2,771	− 607	− 8,050	− 10,921	− 3,378	− 13,692
Housing (T_2H_1)	15.10(B)	—	456,951	153,333	280,565	610,284	737,516	433,898	890,849
	TOTAL	2,576,648	2,559,848	2,592,753	2,588,256	2,572,882	2,546,833	2,602,633	2,563,715

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TABLE 16.27

Present Worth of Costs at 12% (£)

$R_1T_1H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C+D
Water Supply	6.8	792,025	603,700	746,719	701,926	558,404	513,601	656,630	468,305
Agriculture (R_1)	7.27(A)	1,100,690	854,130	1,030,470	923,054	783,910	676,494	852,834	606,274
Sewage Disposal	8.3	312,988	287,426	299,796	294,759	275,234	269,602	281,567	259,221
G.P.O. Telephones	9.5	9,845	6,694	8,943	8,145	5,792	4,994	7,243	4,092
Electricity Supply	10.7	26,467	29,810	27,188	28,856	26,377	28,510	29,577	25,077
G.P.O. Mail	11.5	95,931	77,621	87,618	85,345	69,381	64,509	75,294	58,306
Schools	12.5	238,702	221,101	238,702	241,134	221,101	221,101	241,134	221,101
Travel to Work etc. (R_1T_1)	13.23(A)	—	66,771	4,225	64,478	70,996	94,856	68,703	99,081
Miscellaneous Transport	14.6	—	− 5,279	− 2,771	− 607	− 8,050	− 10,921	− 3,378	− 13,692
Housing (T_1H_2)	15.10(E)	—	360,608	120,824	199,605	481,432	560,213	320,429	681,037
	TOTAL	2,576,648	2,502,582	2,561,714	2,546,695	2,484,577	2,422,959	2,530,033	2,408,802

TABLE 16.28

Present Worth of Costs at 12% (£)

$R_1T_2H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	792,025	603,700	746,719	701,926	558,404	513,601	656,630	468,305
Agriculture (R_1)	7.27(A)	1,100,690	854,130	1,030,470	923,054	783,910	676,494	852,834	606,274
Sewage Disposal	8.3	312,988	287,426	299,796	294,759	275,234	269,602	281,567	259,221
G.P.O. Telephones	9.5	9,845	6,694	8,943	8,145	5,792	4,994	7,243	4,092
Electricity Supply	10.7	26,467	29,810	27,188	28,856	26,377	28,510	29,577	25,077
G.P.O. Mail	11.5	95,931	77,621	87,618	85,345	69,381	64,509	75,294	58,306
Schools	12.5	238,702	221,101	238,702	241,134	221,101	221,101	241,134	221,101
Travel to Work etc. (R_1T_2)	13.23(B)	—	27,694	2,755	25,079	30,449	41,427	27,834	44,182
Miscellaneous Transport	14.6	—	− 5,279	− 2,771	− 607	− 8,050	− 10,921	− 3,378	− 13,692
Housing (T_2H_2)	15.10(F)	—	357,663	120,181	197,621	477,844	555,284	317,802	675,465
	TOTAL	2,576,648	2,460,560	2,559,601	2,505,312	2,440,442	2,364,601	2,486,537	2,348,331

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TABLE 16.29

Present Worth of Costs at 12% (£)

$R_2T_1H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	792,025	603,700	746,719	701,926	558,404	513,601	656,630	468,305
Agriculture (R_2)	7.27(B)	1,159,704	885,373	1,086,013	954,297	811,682	679,966	880,606	606,274
Sewage Disposal	8.3	312,988	287,426	299,796	294,759	275,234	269,602	281,567	259,221
G.P.O. Telephones	9.5	9,845	6,694	8,943	8,145	5,792	4,994	7,243	4,092
Electricity Supply	10.7	26,467	29,810	27,188	28,856	26,377	28,510	29,577	25,077
G.P.O. Mail	11.5	95,931	77,621	87,618	85,345	69,381	64,509	75,294	58,306
Schools	12.5	238,702	221,101	238,702	241,134	221,101	221,101	241,134	221,101
Travel to Work etc. (R_2T_1)	13.23(C)	—	70,113	4,754	67,686	74,867	101,407	72,440	106,162
Miscellaneous Transport	14.6	—	− 5,279	− 2,771	− 607	− 8,050	− 10,921	− 3,378	− 13,692
Housing (T_1H_1)	15.10(A)	—	459,896	153,976	282,549	613,872	742,445	436,525	896,421
	TOTAL	2,635,662	2,636,455	2,650,938	2,664,090	2,648,660	2,615,214	2,677,638	2,631,267

TABLE 16.30

Present Worth of Costs at 12% (£)

$R_2T_2H_1$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	792,025	603,700	746,719	701,926	558,404	513,601	656,630	468,305
Agriculture (R_2)	7.27(B)	1,159,704	885,373	1,086,013	954,297	811,682	679,966	880,606	606,274
Sewage Disposal	8.3	312,988	287,426	299,796	294,759	275,234	269,602	281,567	259,221
G.P.O. Telephones	9.5	9,845	6,694	8,943	8,145	5,792	4,994	7,243	4,092
Electricity Supply	10.7	26,467	29,810	27,188	28,856	26,377	28,510	29,577	25,077
G.P.O. Mail	11.5	95,931	77,621	87,618	85,345	69,381	64,509	75,294	58,306
Schools	12.5	238,702	221,101	238,702	241,134	221,101	221,101	241,134	221,101
Travel to Work etc. (R_2T_2)	13.23(D)	—	29,483	3,015	26,703	32,498	44,840	29,718	47,856
Miscellaneous Transport	14.6	—	− 5,279	− 2,771	− 607	− 8,050	− 10,921	− 3,378	− 13,692
Housing (T_2H_1)	15.10(B)	—	456,951	153,333	280,565	610,284	737,516	433,898	890,849
	TOTAL	2,635,662	2,592,880	2,648,556	2,621,123	2,602,703	2,553,718	2,632,289	2,567,389

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TABLE 16.31

Present Worth of Costs at 12% (£)

$R_2T_1H_2$

Item	Table	*Area Relocated*							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	792,025	603,700	746,719	701,926	558,404	513,601	656,630	468,305
Agriculture (R_2)	7.27(B)	1,159,704	885,373	1,086,013	954,297	811,682	679,966	880,606	606,274
Sewage Disposal	8.3	312,988	287,426	299,796	294,759	275,234	269,602	281,567	259,221
G.P.O. Telephones	9.5	9,845	6,694	8,943	8,145	5,792	4,994	7,243	4,092
Electricity Supply	10.7	26,467	29,810	27,188	28,856	26,377	28,510	29,577	25,077
G.P.O. Mail	11.5	95,931	77,621	87,618	85,345	69,381	64,509	75,294	58,306
Schools	12.5	238,702	221,101	238,702	241,134	221,101	221,101	241,134	221,101
Travel to Work etc. (R_2T_1)	13.23(C)	—	70,113	4,754	67,686	74,867	101,407	72,440	106,162
Miscellaneous Transport	14.6	—	− 5,279	− 2,771	− 607	− 8,050	− 10,921	− 3,378	− 13,692
Housing (T_1H_2)	15.10(E)	—	360,608	120,824	199,605	481,432	560,213	320,429	681,037
	TOTAL	2,635,662	2,537,167	2,617,786	2,581,146	2,516,220	2,432,982	2,561,542	2,415,883

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TABLE 16.32

Present Worth of Costs at 12% (£)

$R_2T_2H_2$

Item	Table	Area Relocated							
		None	B	C	D	B + C	B + D	C + D	B + C + D
Water Supply	6.8	792,025	603,700	746,719	701,926	558,404	513,601	656,630	468,305
Agriculture (R_2)	7.27(B)	1,159,704	885,373	1,086,013	954,297	811,682	679,966	880,606	606,274
Sewage Disposal	8.3	312,988	287,426	299,796	294,759	275,234	269,602	281,567	259,221
G.P.O. Telephones	9.5	9,845	6,694	8,943	8,145	5,792	4,994	7,243	4,092
Electricity Supply	10.7	26,467	29,810	27,188	28,856	26,377	28,510	29,577	25,077
G.P.O. Mail	11.5	95,931	77,621	87,618	85,345	69,381	64,509	75,294	58,306
Schools	12.5	238,702	221,101	238,702	241,134	221,101	221,101	241,134	221,101
Travel to Work etc. (R_2T_2)	13.23(D)	—	29,483	3,015	26,703	32,498	44,840	29,718	47,856
Miscellaneous Transport	14.6	—	− 5,279	− 2,771	− 607	− 8,050	− 10,921	− 3,378	− 13,692
Housing (T_2H_2)	15.10(F)	—	357,663	120,181	197,621	477,844	555,284	317,802	675,465
	TOTAL	2,635,662	2,493,592	2,615,404	2,538,179	2,470,263	2,371,486	2,516,193	2,352,005

TABLE 16.33

Net Benefits of Relocation: All Sectors (£)

Present Worth at 6%

Assumptions	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B + C + D
$R_1T_1H_1$	197,608	51,463	75,881	252,224	345,522	130,179	393,865
$R_1T_2H_1$	267,075	55,072	144,327	325,300	442,596	202,234	494,548
$R_1T_1H_2$	296,896	84,615	158,825	384,664	527,754	246,275	609,249
$R_1T_2H_2$	366,363	88,224	227,271	457,740	624,828	318,330	709,932
$R_2T_1H_1$	222,465	54,456	100,874	280,074	395,372	158,165	446,708
$R_2T_2H_1$	293,512	58,339	170,932	355,004	495,638	232,106	550,857
$R_2T_1H_2$	321,753	87,608	183,818	412,514	577,604	274,261	662,092
$R_2T_2H_2$	392,800	91,491	253,876	487,444	677,870	348,202	766,241

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TABLE 16.34

Net Benefits of Relocation: All Sectors (£)

Present Worth at 8%

Assumptions	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B + C + D
$R_1T_1H_1$	99,779	20,889	19,280	123,782	181,257	42,523	200,049
$R_1T_2H_1$	157,193	23,840	75,840	184,147	261,328	102,034	283,071
$R_1T_1H_2$	199,067	54,041	102,224	256,222	363,489	158,619	415,433
$R_1T_2H_2$	256,481	56,992	158,784	316,587	443,560	218,130	498,455
$R_2T_1H_1$	124,487	23,865	44,123	151,466	230,808	70,342	252,576
$R_2T_2H_1$	183,472	27,088	102,286	213,674	314,052	131,728	339,043
$R_2T_1H_2$	223,775	57,017	127,067	283,906	413,040	186,438	467,960
$R_2T_2H_2$	282,760	60,240	185,230	346,114	496,284	247,824	554,427

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TABLE 16.35

Net Benefits of Relocation: All Sectors (£)

Present Worth at 10%

Assumptions	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B + C + D
$R_1T_1H_1$	28,263	− 1,477	− 22,085	29,879	61,207	− 21,560	58,391
$R_1T_2H_1$	76,876	1,015	25,799	80,985	128,862	28,816	128,538
$R_1T_1H_2$	127,551	31,675	60,859	162,319	243,439	94,536	273,775
$R_1T_2H_2$	176,164	34,167	108,743	213,425	311,094	144,912	343,922
$R_2T_1H_1$	52,830	1,482	2,617	57,405	110,476	6,101	110,619
$R_2T_2H_1$	103,005	4,244	52,094	110,342	181,286	58,340	184,191
$R_2T_1H_2$	152,118	34,634	85,561	189,845	292,708	122,197	326,003
$R_2T_2H_2$	202,293	37,396	135,038	242,782	363,518	174,436	399,575

TABLE 16.36

Net Benefits of Relocation: All Sectors (£)

Present Worth at 12%

Assumptions	*Area Relocated*						
	B	C	D	B + C	B + D	C + D	B + C + D
$R_1T_1H_1$	− 25,222	− 18,218	− 52,991	− 40,369	− 28,543	− 69,481	− 47,538
$R_1T_2H_1$	16,800	− 16,105	− 11,608	3,766	29,815	− 25,985	12,933
$R_1T_1H_2$	74,066	14,934	29,953	92,071	153,689	46,615	167,846
$R_1T_2H_2$	116,088	17,047	71,336	136,206	212,047	90,111	228,317
$R_2T_1H_1$	793	− 15,276	− 28,428	− 12,998	20,448	− 41,976	4,395
$R_2T_2H_1$	42,782	− 12,894	14,539	32,959	81,944	3,373	68,273
$R_2T_1H_2$	98,495	17,876	54,516	119,442	202,680	74,120	219,779
$R_2T_2H_2$	142,070	20,258	97,483	165,399	264,176	119,469	283,657

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16.2. The Importance of Different Factors and Assumptions

16.2.1 The following table sets out the effect of different factors on the results, taking the alternatives of no relocation and maximum relocation (the most favourable of the different relocation solutions).

TABLE 16.37

Effect of Different Factors (£'000) (+ favours relocation)

	$R_2T_2H_2$ at 6% (most favourable to relocation)			$R_1T_1H_1$ at 12% (least favourable to relocation)		
	No Relocation	B + C + D	Difference	No Relocation	B + C + D	Difference
Water	852	509	+ 343	792	468	+ 324
Agriculture (R)	1,890	962	+ 964	1,101	606	+ 495
Sewage ...	353	282	+ 71	313	259	+ 54
Telephones ...	16	6	+ 10	10	4	+ 6
Electricity ...	39	27	+ 12	26	25	+ 1
Mail	156	95	+ 61	96	58	+ 38
Schools ...	373	323	+ 50	239	221	+ 18
Travel (R.T.) ...	—	78	− 78	—	99	− 99
Transport ...	—	−22	+ 22	—	−14	+ 14
Housing (T.H.)	—	692	− 692	—	896	− 896
TOTAL* ...	3,681	2,914	+ 766	2,577	2,624	− 48

* These totals may not tally exactly due to rounding.

16.2.2 This suggests that, in areas similar to South Atcham, water supply, agriculture and housing are likely to be the most important factors to consider.

16.2.3 The following table separates the effect of the discount rate and the RTH assumptions on the results.

TABLE 16.38

Effect of Discount Rate and Combined Alternative Assumptions (£'000)

Net benefit of relocation	6%	12%	Difference
$R_2T_2H_2$	766	284	482
$R_1T_1H_1$	394	−48	442
Difference	372	332	—

This shows a reduction of about £460,000 in the net benefit of relocation as the discount rate is increased from 6% to 12%, and a reduction of about £350,000 if the assumptions are changed from $R_2T_2H_2$ to $R_1T_1H_1$, the total reduction being about £810,000.

16.2.4 Taking each assumption in turn, the net benefit of B + C + D relocation is reduced by changing assumptions as follows:—

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TABLE 16.39

Variation of Net Benefit with R.T. & H. Assumptions Varied Separately (£'000)

	6%	8%	10%	12%
R_2R_1	55	55	55	55 } approx.
T_2T_1	102	84	72	62 }
H_2H_1	215	215	215	215 }

In short, the variation in the valuation of housing is the most important alternative.

16.2.5 Turning next to each of the three main factors, the net savings on water supply that result from relocation do not vary greatly with the discount rate and are not affected by alternative assumptions. The margin of error is probably small here since the figures are based on detailed estimates.

16.2.6 The figures for housing vary little with the discount rate and not greatly with the valuation of non-working time. The variation in estimated values, extending over a range of £215,000, is the important element here.

16.2.7 The net benefit from reorganising agriculture varies with the employment assumption and discount rate as follows:—

TABLE 16.40

Variation of Agriculture Figures (£'000)

Net benefit of relocation	6%	12%	Difference
R_2	964	554	410
R_1	904	495	410
Difference	60	60	—

This shows a variation of £410,000 with the discount rate and only £60,000 with the employment assumption: this accounts for most of the change in the total net benefit with the discount rate. The figures do not, however, allow for any margin of error in estimation, which may be large, given that the total costs for agriculture are large.

16.2.8 Most of the relatively minor factors are not affected by alternative assumptions and are not liable to very great margins of error, the totals from which the differences are derived being relatively small. This does not, however, apply to travel and transport, where the calculations are in difference terms from the beginning and the margin of error may be greater.

16.2.9 To sum up, the results of the study vary from a £766,000 net benefit from maximum relocation on the most favourable set of assumptions to a net

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loss of £48,000 on the least favourable set. The most important factors are the cost of extending water supplies and maintaining agriculture in its present form on the one hand and the cost of abandoning existing housing on the other. The results are most sensitive to the discount rate, which accounts for more than half the total variation: they are also sensitive to the margin of error calculated on the valuation of existing housing, and there will also be some margin of error which has not been calculated in the agricultural figures. The implications of these results are discussed in the next chapter.

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17. Conclusion

17.1. General Implications of the Study

17.1.1 This study was intended both to examine the social costs and benefits of the proposed South Atcham water supply scheme and, as a pilot study, to explore the usefulness of cost-benefit analysis as a routine method of appraising future proposals of this kind. In this chapter these various threads will be drawn together by considering, first, the implications of the results for the proposed water supply scheme for South Atcham and secondly, some problems involved in the implementation of a policy of relocation, special attention being paid to certain intangible factors not covered in the earlier analysis. Finally, the possible application of cost-benefit techniques to the appraisal of water supply schemes elsewhere is reviewed.

17.2. Implications for South Atcham

17.2.1 Within the policy limitations accepted in the context of the study, the results show that relocation would be preferable to the water supply scheme so far as quantified factors are concerned, for most of the possible sets of circumstances examined. Working within this framework, the next step should be to select the appropriate set of assumptions regarding redundancy periods, the value of non-working time, house values and the rate of discount. If the assumptions chosen gave a result in favour of relocation, the decision-maker would have to consider the likely margin of error in the estimates, intangible factors not quantified in the report and the practical difficulties of implementation, and weigh these in the balance with the net quantified advantages of relocation. It is quite possible that in the light of these considerations a dramatic change of policy as far as the South Atcham scheme itself is concerned would not be regarded as justifiable, despite the apparent (quantifiable) net benefits resulting from relocation. We might also wish to consider other courses of action outside the scope of this study, some of which are discussed later in this chapter. First, however, the practical difficulties of relocation and the question of intangibles are further discussed.

17.3. A Policy of Relocation

17.3.1 If it were decided that relocation was the right policy for South Atcham, this might be followed by several types of policy measure concerning the pricing and financing of services, agricultural reorganisation and the re-allocation of functions between administrative units. Strictly speaking, policy implications of this sort fall outside the scope of the present inquiry, but one possible course of action is briefly discussed, since it might involve further calculations of the kind described on the preceding pages.

17.3.2 In the first place, although estimates have been made of the cost of providing services of a given quality to all properties in existing locations, as well as the cost of doing so if all householders were relocated, it is quite apparent

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that the latter situation would seldom be realised in practice. There can be no question of compulsorily ordering people to abandon properties other than those that are unfit, on other grounds, for human habitation; on the other hand, one has only to observe how reluctant some people are to move from urban slums (let alone from the sort of property to be found in the study area) to new accommodation to appreciate the difficulty of securing voluntary co-operation.

17.3.3 Rather more concrete evidence that this would be so was in fact provided by answers to the questionnaire which was devised mainly for the travel survey.[1] Of the 162 householders interviewed in Areas B, C and D, only six (i.e. 4%) had made a positive effort to move and were on local authority or estate agents' waiting lists (questions (h) and (j)). Of these, four expressed a desire to move in order to obtain better facilities, and two wished to move to be closer to relations.

17.3.4 Only one of the six householders expressing a desire to move lived in the area because of its proximity to his place of employment. The others had originally settled in the area because of the amenity provided by scenery or seclusion, but this had obviously not stood the test of time. Out of all households, however, 66% lived in the area to be close to their job (i.e. farming), and the remaining 30%, whether retired or working in Shrewsbury or elsewhere outside the area, lived there simply because they liked it (g). The average length of time dwellings in Areas B, C and D had been occupied by the same family was, in fact, 13 years (f).

17.3.5 Despite the obvious attachment people have for the area, there would, for most house owners, probably be some sum of money which they would be prepared to accept in return for giving up their present homes, and it is along these lines that use could be made of a cost-benefit study of the effect of relocation. Thus, if relocation showed a net social benefit in monetary terms, the following course of action could possibly be followed.

17.3.6 First, it has been noted that the constraint within which current water supply policy operates is not that all properties should be connected to mains supplies, but that as far as possible householders should be *given the opportunity* to connect—which is a very different thing. The least cost method of meeting the latter constraint would therefore be achieved by giving people the opportunity to be rehoused, so the originally planned water scheme could be abandoned. The next step might be to inform residents of the health hazard attached to the continued consumption of private supplies,[2] and in order to encourage them to move, they should be offered compensation equal to the market value of their homes plus a removal grant, this addition being necessary since a sum in excess of the market price of properties would normally have to be offered to induce people to move.

17.3.7 The size of the removal grant would be partly a matter of equity. Since relocation would permit society at large to meet the above-mentioned

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[1] See Appendix II.

[2] Ideally, as we have observed, the monetary cost of the health risk should be incorporated into the cost-benefit calculation.

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constraint at a lower cost, then allowing for the fact that some of the financial effects would be felt directly by the parties concerned, the grant can be seen as payment for making this saving possible. Thus, an upper limit to the total grant payable could be the total saving achieved.

17.3.8 One method of allocating such a grant would be to offer to share the total saving among property owners[1] in the area, either in proportion to the value of the properties or as a sum equal for all houses, irrespective of value. *A priori*, one cannot say which would be the better method; both would be very rough and ready, but more sophisticated calculations, based upon the cost savings achieved by the abandonment of individual properties, would probably present too many informational difficulties.[2]

17.3.9 Even though householders might not take advantage of the offer of a removal grant, society would by this means fulfill any obligation it might have of providing the opportunity of connection to the mains. In fact, this solution would not differ in principle from current policy, largely because connection to mains is not usually enforced unless the property concerned is considered to be a 'reasonable' distance from the appropriate main. The alternative method would in fact be an improvement to the extent that there would no longer be a financial barrier facing persons wishing to obtain mains water supplies; certainly, many outlying properties normally served by the South Atcham scheme would not be connected to the mains because of the high cost of doing so. The advantage of the scheme would therefore be that the opportunity given to people to connect could be achieved more cheaply, and for the occupiers of outlying properties in particular, that opportunity would become more realistic.

17.3.10 The scheme would place the burden of responsibility firmly on the householders in the area as far as the health risk is concerned, hence the stipulation that this should be extensively publicised when the rehousing scheme is announced. Having provided the necessary information, there would then be absolute freedom of choice for individuals to continue to live where they do at present. Unfortunately, this does not take account of external effects[3] that may result from drinking unsatisfactory water supplies, but this is a characteristic that the scheme would have in common with the present system in which connection is not always enforced.

17.3.11 Ideally, as we have noted, these external effects should be measured in monetary terms. If the external costs resulting from the consumption of private water supplies exceed the net cost of taking water to existing properties,[4] there is no escape from either

(a) carrying out the original scheme, this being accompanied by compulsory connection, or
(b) compulsory rehousing.

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[1] Slightly different arrangements would be necessary where tenanted properties are concerned, but the details do not concern us here.

[2] This point has been made before. (See paragraph 4.1.4.)

[3] As defined in paragraph 3.2.1. These would also include external effects of using private supplies for certain agricultural purposes.

[4] Or, even if this is not so in monetary terms, society, on the basis of knowledge of the monetary costs involved, deems that on humanitarian grounds the risk must be avoided altogether.

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17.3.12 In these circumstances, therefore, radical changes of policy would be unavoidable. *Prima facie*, this is merely an academic point, for if current policy concerning the obligation to connect is to be used as a guide, the presently accepted view must be that external effects are not likely to be of this order of magnitude. Nevertheless, as we have already noted,[1] sensible decisions in this field can only be made if the effects of the 'do nothing' solution are rigorously investigated.

17.3.13 The calculations on the preceding pages were based upon the extreme hypothesis that all householders would be relocated. This was useful for purposes of cost comparison, and because it was necessary to the logic of the exercise in which public health had assumed a position of dominant importance. If in fact all householders took advantage of the rehousing offer, the calculations would have specified the amount of compensation that could be shared among them, while if no one were to accept, the total saving to society could be readily calculated from the data presented. Failure to accept would reveal, as an approximation, that over and above the market value of their properties, property owners place a value on living where they are now (without water) that is greater than the alternative (including water) by an amount that is at least as high as the social saving that rehousing would permit. Clearly, the higher the net saving from relocation, the greater the sum payable, and the less will people be inclined to take such a view.

17.3.14 The most likely result would be that some people would accept the offer and some would not. If some householders opt for relocation, leaving the remainder of the area concerned inhabited, it is conceivable that in terms of cost the result could be the worst of both worlds. Thus, it is possible that the net cost of providing services (except water) for existing properties that remain inhabited, plus services (including water) to the relocation sites, could be greater than the net cost of providing all services for the existing settlement pattern. If so, the original water scheme would be a cheaper method of allowing those who opt for rehousing to obtain mains supplies, and partial relocation would be the worst possible solution. The rehousing offer would, in these circumstances, have to be withdrawn.

17.3.15 Such situations would doubtless be rare, but the possibility would require investigation by the use of a second cost-benefit calculation, made in the light of the number and type of property owners accepting the offer. Most of the data would be available from the original estimates, so this should not present too great a problem. As the opportunity for rehousing should continue to be open to people in future years, estimates of the probable time pattern of acceptance would have to be incorporated into the second set of estimates.

17.3.16 It is not essential to the logic of the exercise that all people accepting the offer of removal grants should in fact decide to move to the specified relocation sites, and although this could be encouraged, it would be impracticable

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[1] See Chapter 3.

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to insist upon it.[1] As a general principle, there is no reason why the marginal net saving achieved by moving to a relocation village should differ markedly from that resulting from moving to another property outside the study area. An exception to this rule is, however, provided by agricultural workers: if in fact it turned out that people preferred to move from the area altogether, so that even the new (smaller) agricultural labour force required could not be recruited, this effect, too, would have to be incorporated in the second cost-benefit calculation.

17.3.17 So far, farming has not been explicitly dealt with in this section, but it should be noted that if there is less than 100% acceptance of the rehousing alternative by the farming community, specific attention would have to be paid to the quality of private water supplies in the study area, and the consequence of this for the type of farming that would be permitted. This question was avoided in the chapter dealing with agriculture: 100% relocation would itself rule out dairy farming because of the distance factor. On the other hand, if people reject the rehousing alternative and continue to use farm houses for residential purposes, the continuation of dairy farming would depend upon the quality of water used for this purpose. Each case would have to be considered on its own merits: if the water is considered satisfactory for dairying, the type of farming need not change nor, therefore, would there be the stimulus towards amalgamation described in Chapter 7. The second set of calculations would also have to take account of this possibility.

17.3.18 Finally, there are numerous possible variations on the theme discussed in this section. The solution examined is purely hypothetical, and serves mainly to illustrate some of the problems that would appear in attempting to achieve the advantages of relocation by relying upon the voluntary co-operation (albeit aided by financial incentives) of inhabitants of the study area.

17.4. 'Intangibles'

17.4.1 Little more time need be spent on 'intangibles', those consequences of retention or abandonment of existing properties that cannot be quantified in monetary terms. This is not to say that they are unimportant: they are, of course, of overwhelming importance, but receive little discussion in the present exercise simply because the economist is not particularly well qualified to pronounce upon the subject.

17.4.2 Among the intangible effects of relocation, the following costs can be listed, even where the voluntary principle described in the previous section is employed:—

(a) Depopulation of pleasant villages and a growing number of derelict properties to be found in the countryside would inflict costs in terms of visual amenity to those remaining in the area and to tourists.

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[1] Thus, should a property owner decide to move out of the area for reasons unconnected with the present scheme (or dies), the removal grant would be a 'windfall' bonus to him (or to his estate).

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(b) The increased population of the villages selected for relocation sites may, for reasons of landscape beauty or historical interest, be considered unsuitable for development. Acton Burnell, Leebotwood and Longnor could all come within this category.[1]

(c) Where farmers are not permitted, because of the quality of water supplies, to continue their present type of farming, they may be forced to lose their independence and the 'rural way of life', etc., which cannot adequately be measured in monetary terms. This also applies to those farmworkers who may have to obtain employment elsewhere as a result of amalgamations and increased efficiency of farms. On the other hand, the concentration of population in small villages might help to preserve the rural way of life, by arresting depopulation of an area which might otherwise occur if people had to choose between remaining in isolated houses or moving out of the area into nearby towns or other parts of the country.

(d) There may be costs in terms of public health if, even after extensive publicity, the rehousing alternative is not generally accepted. This may or may not be offset by benefits to those persons who can now opt for satisfactory water supplies by moving to the relocation sites, but who would have found it too expensive to connect to the original scheme. Even if these effects can be quantified in monetary terms, there will still be an intangible 'residual' which cannot be so measured.

17.4.3 Should the relocation alternative show a net saving to society, the policy-maker would have to decide whether or not the extent of the saving is sufficient to justify the intangible costs that would result. The economist has no further part to play in this decision.

17.5. Further Application of Cost-Benefit Methods

17.5.1 This study seems to demonstrate that cost-benefit methods can successfully be applied to the extension of mains supplies in rural areas, and that bringing together all the costs of alternative policies does throw new light on the problem. As a result, if the policy constraints accepted for this pilot project were confirmed by decision-makers, it would be possible to employ a reasonably streamlined method for appraising other schemes in areas similar to South Atcham.

17.5.2 As a first approximation, work could concentrate on the cost of water supplies, the impact on agricultural activity and the valuation of existing housing. The selection of appropriate relocation sites should be facilitated by knowledge of what are potentially the most important consequences of relocation, as demonstrated in the present study. A discount rate, comparable to the planning rate postulated for the nationalised industries, would then need to be determined. If the balance of advantage, one way or another, then proved to be so small as to lie within the margin of error to which the estimates were subject, further work would be necessary, but it is probable that in many cases the result would be clear-cut on the first round. The practical problems outlined in the preceding two sections would, of course, remain relevant.

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[1] See Salop County Council Planning Department Interim Report on Village Development, Part 2.

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17.5.3 It may not, however, be possible to employ this streamlined method to an area displaying markedly different characteristics to those of South Atcham, and in these circumstances further full-scale study of that area might be unavoidable. For instance, in more remote regions, the transport and travelling implications might be much more important, and the implications for agriculture would also vary considerably in different parts of the country. In fact, as we have noted, South Atcham is not typical of many areas for which proposals for mains water supply are likely to be forthcoming, in that it is relatively densely populated and accessible to several sizeable centres of population. One would expect, *a priori*, that if relocation is a somewhat more economical solution to the water supply problem here, it will certainly be more economical in more remote and less densely populated areas. In other cases it might be possible to relocate entirely to places where the existing mains supply was adequate, which would again favour relocation. The following characteristics worked unfavourably for the relocation alternative in South Atcham:—

(a) The cost of providing mains water was reduced by the existence of some piped supplies already in some locations.

(b) Many of the public services which showed relatively minor savings from relocation did so because of the proximity of Shrewsbury (to the north) and Church Stretton and Much Wenlock (to the south-west and south-east respectively), the consequence of which being that services were crossing or passing close to the area anyway to connect the former town with the other two. A more remote (i.e. peripheral) area might be affected very differently.

(c) The average value of existing houses was around £3,000, and this could well be much lower in a more remote area.

On the other hand, circumstances favouring relocation in South Atcham were as follows:—

(a) The prior (independent) decision to provide main drainage for a substantial part of Area A reduced the additional cost of sewage disposal to be charged against the relocation scheme.

(b) In South Atcham agricultural activity includes a high proportion of dairying, pigs and poultry which, upon relocation, would have to be abandoned in favour of beef or sheep. The initially high capital costs of this conversion were more than offset by the present worth of the annual net benefits resulting from the change. This is clearly a feature which can be expected to vary greatly from one area to another.

17.5.4 If further study indicated that relocation might produce greater net benefits than the extension of water supplies in many of the areas not yet supplied, this would heighten the need to consider the practical difficulties of relocation. Moreover, as we have made clear, certain other options have not been systematically appraised in this study. It was noted earlier that it was not possible to obtain any statistical evidence to support the existence of the health hazard, which consequently had to be accepted as a constraint having to be met by all the alternatives being examined. This obviously requires further consideration. There might also be further ways of meeting the health hazard which

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fall short of a full-scale mains system for water supplies; the reduction of contamination of present supplies through improved sewage disposal facilities or by local treatment of existing sources of supply would be examples of the way in which this might be done. In other areas the problem may be one of the quantity of water available, rather than its quality, which might also raise possibilities which have not been considered here. If it were decided to pursue any one of these other options, there is no reason why methods similar to those used in this study should not be employed.

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Appendix I

EXISTING W.S.W.B. SUPPLIES IN CARDINGTON:

A THEORETICAL NOTE

In paragraph 4.3.11 it was stated that although 35 out of the 45 houses in Cardington village currently obtain a supply from the W.S.W.B., the local source is too small to allow extension of this supply to the remaining ten houses. Abandonment of properties would therefore, it was suggested, be restricted to these ten properties.

On pure efficiency grounds, however, there may be a case for ensuring that the 35 *most valuable* properties are connected; i.e. there may be circumstances in which valuable properties should be substituted for poorer ones which are currently connected to the mains and which would involve a smaller monetary cost should they be abandoned. The theoretically optimal solution would be to maximise the objective function

$$N = V - K \qquad \text{(I.1)}$$

where N = net benefit,
V = value of connected properties (P), and
K = cost of connecting properties to mains supplies,

subject to the constraint that desired consumption, (C), does not increase.

There is, however, a presumption implicit in the method of financing domestic water supply, that water consumption per household varies positively with the (rateable) value of the properties concerned, as well as with the actual number of properties. This could be expressed as a linear relationship such as

$$C = c_1 V + c_2 P + \ldots\ldots\ldots\ldots + c_n n \qquad \text{(I.2)}$$

in which case the constraint

$$c_1 V + c_2 P + \ldots\ldots\ldots\ldots + c_n n = Z \qquad \text{(I.3)}$$

would have to be satisfied, where Z represents the current rate of consumption.

We therefore maximise the Lagrangian expression

$$N = V - K + \lambda (c_1 V + c_2 P + \ldots\ldots\ldots\ldots + c_n n - Z) \qquad \text{(I.4)}$$

$$\text{i.e.} \quad \frac{\delta N}{\delta P} = \frac{dV}{dP} - \frac{dK}{dP} + \lambda \left(c_1 \frac{dV}{dP} + c_2\right) = O \qquad \text{(I.5)}$$

subject to the second order conditions being satisfied. Here λ can be interpreted as the social loss implied by the constraint that consumption has to remain constant. If total water consumption is in fact unaffected by the substitution of properties of greater value (i.e. $c_1 = O$), the constraint merely concerns the *number* of properties involved, and maximisation condition is

$$\frac{\delta N}{\delta P} = \frac{dV}{dP} - \frac{dK}{dP} + \lambda c_2 = O \qquad \text{(I.6)}$$

If condition (I.6) is the relevant one, the number of properties remaining connected to the mains could continue to be 35, even though the actual properties

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making up this number might change. On the other hand, should c_1 be non-zero, the optimal solution could involve the abandonment of properties greater or smaller in number than those currently unconnected.

The argument expressed in this note is mainly of theoretical interest: in fact, the original stipulation that properties already connected should remain so, while the others should be abandoned, is probably quite a reasonable one. The scope for substituting higher-value for poorer properties is, as a general principle, limited because of the additional water consumption that would probably follow, making the Cardington source unsafe. (Another constraint within which we operate, therefore, is that existing supplies will not be rationed by use of the price mechanism, and we reject the physical rationing methods of the sort that sometimes are used in emergency.) *Prima facie*, a further practical justification for this approach might be the probability that valuable properties are more likely to be already connected to a satisfactory source of supply than poorer ones, although this is not in fact substantiated by inspection of rateable value figures for Cardington itself.

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Appendix II

TRAVEL SURVEY FORM

(*a*) Name and Address .....
(*b*) Water Board Survey No. ( ) Rating No. ( ) Rateable Value (£)
(*c*) Family Details: Adults ( ) Children ( ) Infants ( )
(*d*) *Journeys to Work*

	Occupation	Place of Work/School	Mode of Transport	Own Car?	Distance
1					
2					
3					
4					
5					
6					

Comment

(*e*) *Other Routine Journeys*

	Shopping			Entertainment			Other Specify: Market, business, etc.		
	Place	Times	Mode	Place	Times	Mode	Place	Times	Mode
1									
2									
3									
4									
5									
6									

Comment

(*f*) *How long hos family lived in dwelling*?
(*g*) *Reason for living here.*
(Proximity to job/inherited/amenity/retirement/weekend home/commute to Shrewsbury, etc.)
(*h*) *Has family made any positive effort to move?*
(*j*) *If yes, local outhority woiting list/estate agents' woiting list?*
(*k*) *If answer to question* (*h*) *is yes, where would family like to move?*
(*l*) *Reason for wanting to move.*
(School/entertainment/job/condition of house/other.)

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Appendix III

A NOTE ON JOURNEYS MADE BY FARMERS FOR BUSINESS PURPOSES

This note explains the method employed to estimate the effect of relocation on journeys made by farmers for business purposes, journeys to market being a typical example. The costs of such journeys are insignificant, and their estimation only of theoretical interest as far as the present exercise is concerned, but the method itself is of general relevance; it would no doubt be a more important consideration in a larger, more scattered region than South Atcham.

Which Journeys should be Included?

Prior to relocation, some journeys would be made that subsequently would not. The most important of these are journeys to market, etc., made by farmers who, upon relocation, would be made redundant. The question at issue is whether or not the consequent reduction in travel should properly be included as a saving accruing from relocation.

The answer is that it *should be*, but not under the present heading. The reason for this is that, theoretically, the saving accruing from a reduction in the labour force and changes in 'fixed' costs (of which business journeys are one component) are taken into account in the estimates made of the effect of relocation on the value of net agricultural output.

i.e. estimates were made as follows:—

$$\sum_{t=0}^{n} \frac{(V_{1t} - W_{1t} - N_{1t})}{(1+r)^t} \qquad \sum_{t=1}^{n} \frac{(V_{2t} - W_{2t} - N_{2t})}{(1+r)^t}$$

where V = gross value of agricultural output,

W = wage cost, and

N = cost of all other inputs, which theoretically include normal business journeys. Average figures for this type of cost were, of necessity, used.

Subscripts 1 and 2 refer, respectively, to pre- and post-relocation solutions.

For journeys made solely for business purposes, therefore, it would be double-counting separately to estimate the savings (both in working time and vehicle operating costs) that accrue because a number of farmworkers are made redundant.

The effects of relocation in the agricultural sector were calculated solely on the basis of changes in farm size and type of output. Apart from the recognition that farmworkers would no longer be resident at their place of work, their actual place of residence was not, even theoretically, taken into account in the calculation. It was therefore necessary to estimate the effect of relocation on retained farmworkers' journeys. We did this for all such farmworkers, but did not allow

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for the possibility that economies of scale in journeys to market, etc., might be achieved once the larger holdings were established, or that the change in type of farming itself involved a greater or smaller number of journeys. This saving was ignored for the same reason as were redundant farmers' journey savings; i.e. theoretically, these economies of scale, etc., were already taken into account—at least partially—elsewhere.

Estimation of Business Journeys made after Relocation

Let D_1 = distance between market, etc., and farm,
D_2 = distance between market and home (after relocation), and
D_3 = distance between home and farm (after relocation).

For any given farmer, D_1 does not necessarily equal $(D_2 + D_3)$.

For journeys other than by farmers, the method used to estimate the effect of relocation corresponded, *mutatis mutandis*, to $2D_1 - 2D_2$, the difference between the return journey from the existing dwelling and that from the relocation site. Upon relocation, $2D_2$ would represent a journey from home to market and home again.

It is, however, unlikely that in every case this sort of pattern would be retained. It is more likely that a visit to the farm would be made on such a day, either on the way to market or upon return. The extreme case would be where the following journey would be made: home, farm, market, farm, home. This is represented by $2D_1 + 2D_3$.

We did not commit ourselves to either of these hypotheses and, while recognising that the latter would be a more likely outcome, we simply took an average of the two; i.e. effect of relocation

$$= 2D_1 - \frac{(2D_2 + 2D_1 + 2D_3)}{2}$$

and estimated post-relocation business journeys on the basis that on such a day the typical journey would be as follows: home, farm, market, home; or home, market, farm, home. $(D_1 + D_2 + D_3.)$

In fact, as we have pointed out, the results for the South Atcham area suggest that relocation would have a negligible effect on total mileage covered on journeys of this sort, i.e. roughly,

$$2D_1 = (D_1 + D_2 + D_3)$$

In aggregate, therefore, (although not necessarily applying to individual farmers)

$$D_1 = (D_2 + D_3).$$

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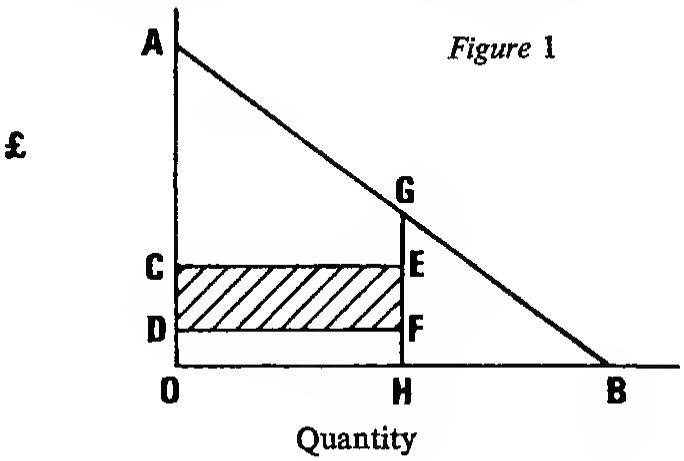
Appendix IV

A NOTE ON THE MEASUREMENT OF BENEFITS

With the exception of the repercussions of relocation on agricultural output and housing, there has been no occasion in this study to measure benefits directly. Given that the standard of amenity remains the same in terms of both quality and quantity, the addition to or reduction in the cost of providing a given service is an adequate measure of the real social cost or benefit of relocation.[1] Subject to 'second-best' difficulties and assumptions concerning constancy of the marginal utility of income, this can be shown in Figure 1.

Figure 1



AB is the demand curve for some service, of which OH is consumed. OAGH represents the gross value of this service to consumers, while OCEH is the total social cost. Relocation now takes place, and although the standard and level of consumption of the service both remain unchanged, total cost falls to ODFH. DCEF is at once the cost-saving, and a measure of the increase in net social benefit, and no complications concerning social surpluses arise.[2]

In dealing with agriculture and housing, however, it is not possible to escape the direct measurement of benefits, for we are no longer dealing with changes of a solely cost-saving (or cost-creating) nature. As far as agriculture is concerned, this does not pose much of a problem because of the presumed highly elastic demand curve facing the individual producers in the area, and in the present context price can be taken as a useful measure of value. Accurately to determine what this price should be is, of course, another and much more serious matter, which has been discussed in the chapter dealing with agriculture.

Housing does present problems of this nature, and these were brought to the fore in the discussion of house improvements. It will be recalled that the notion of consumers' surplus was called upon to justify the assumption that the cost of

[1] For an elaboration of this see P.O. Steiner, 'The Role of Alternative Cost in Project Design and Selection', *Quarterly Journal of Economics*, August 1965.

[2] Although distribution of surpluses between producers and consumers may be affected.

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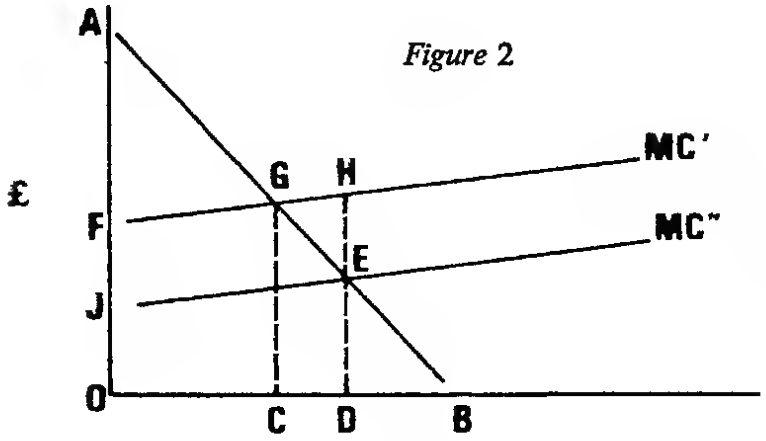
improvements would be matched by an equivalent benefit, this being represented by the total increase in property values. This can be explained in terms of Figure 2, in which AB is the demand curve for improvements: let us say, for simplicity, that the improvements consist of the addition of bathrooms of a given quality and design.

Figure 2



Let MC′ represent the marginal cost householders would incur in installing bathrooms in the absence of any grant system: there is therefore an identity of private and social cost. At the margin, with consumers equating marginal cost with marginal benefits, OC bathrooms will be installed. If a grant system is introduced, the marginal cost curve facing the householder falls to MC″, although the real marginal cost function is unchanged. Installations will now number OD.

At this position the gross benefit of improvements to householders is represented by area OAED, while the total cost to society as a whole is OFHD. If, therefore, X_1 is indeed a true measure of benefit, areas AGF and GHE would have to be equal and the net social surplus zero. No claim is made that this is in fact so; all we are saying is that an area similar to GHE would to some extent offset an area such as AFG. At least this is an improvement on the assumption that $V_2 - V_1 = X_1 - G_1$, which would require the equality OJED = OAED to hold for it to be precisely correct.

This is the only occasion in the present study in which surpluses and areas under demand curves have been used to justify the estimation of benefits. The main purpose of this note is to defend this apparent inconsistency. Thus, as we have indicated, as far as benefits of a purely cost-saving nature and agriculture are concerned, alternative cost and market price, respectively, are adequate measures and these problems do not arise. But they do arise in the case of the benefits obtained from properties currently inhabited in Areas B, C and D and of the benefits that would accrue from newly built houses in the relocation villages. Unfortunately, the extent of the divergence between the market value and true value of these houses cannot be determined, but as relocation would mean a loss of surplus for one group of properties, and a gain for another, the surpluses will to some extent cancel out.

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Very roughly, therefore, within the limitations of the data, the benefits of the various courses of action specifically listed in this study approximate *total* benefits, defined in terms of areas under demand curves. Theoretically, this is of course subject to our basic unit of measurement—price, in both product and factor markets—being representative of true social opportunity costs elsewhere in the economy.

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Appendix V

BUDGETARY IMPLICATIONS FOR PUBLIC BODIES

Estimates were made of the budgetary implications of relocation for the various public bodies involved, the results being presented in Tables V.1 to V.8. As this was very much a subsidiary exercise, the calculation for each relocation possibility rested, for convenience, on a single set of assumptions; i.e. that the appropriate rate of discount is 8%, that there would be no re-employment time lag and that the sample mean of the value of abandoned properties is an acceptable estimate of the population mean. The value of N.W.T. is irrelevant for this exercise. In the case of trading services such as water supply, electricity, telephones and housing, costs were allocated to the body that initially bears them, even though a proportion of those costs would be recovered directly from the consumers concerned. Finally, the calculations continued to be based upon the assumption that *all* properties in each area would be abandoned and their occupiers rehoused.

TABLE V.1

Budgetary Implications for Public Bodies

Present Worth of Costs at 8% (£)

No Relocation

	Atcham R.D.C. (1)	Salop C.C. (2)	Central Gov't.* (3)	W.S. W.B. (4)	Midlands Elect. Board (5)	G.P.O. (6)	Total Cost to Public Bodies (7)
Water Supply[1] ...	—	70,182	70,182	684,996	—	—	825,360
Agriculture[2] ...	—	—	1,065,464	—	—	—	1,065,464
Sewage[3]	183,680	75,775	75,775	—	—	—	335,230
Telephones ...	—	—	—	—	—	13,552	13,552
Electricity	—	—	—	—	33,472	—	33,472
Mail	—	—	—	—	—	129,859	129,859
Schools	—	314,284	—	—	—	—	314,284
Travel to Work, etc.	—	—	—	—	—	—	—
Miscellaneous Transport ...	—	—	—	—	—	—	—
Housing	—	—	—	—	—	—	—
TOTAL ...	183,680	460,241	1,211,421	684,996	33,472	143,411	2,717,221

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TABLE V.2

Area B Relocated (£)

	Atcham R.D.C. (1)	Salop C.C. (2)	Central Gov't.* (3)	W.S. W.B. (4)	Midlands Elect. Board (5)	G.P.O. (6)	Total Cost to Public Bodies (7)
Water Supply[1] ...	—	70,182	70,182	491,612	—	—	631,976
Agriculture[2] ...	—	—	1,230,183	—	—	—	1,230,183
Sewage[3]	151,009	76,825	76,825	—	—	—	304,659
Telephones ...	—	—	—	—	—	8,999	8,999
Electricity	—	—	—	—	34,003	—	34,003
Mail	—	—	—	—	—	105,074	105,074
Schools	—	278,043	—	—	—	—	278,043
Travel to Work, etc.[4]	—	—	− 14,467	—	—	—	− 14,467
Miscellaneous Transport[5] ...	− 723	− 4,843	1,091	—	—	—	− 4,475
Housing[6]	449,920	—	399,100	—	—	—	849,020
TOTAL ...	600,206	420,207	1,762,914	491,612	34,003	114,073	3,423,015

TABLE V.3

Area C Relocated (£)

	Atcham R.D.C. (1)	Salop C.C. (2)	Central Gov't.* (3)	W.S. W.B. (4)	Midlands Elect. Board (5)	G.P.O. (6)	Total Cost to Public Bodies (7)
Water Supply[1] ...	—	70,182	70,182	638,044	—	—	778,408
Agriculture[2] ...	—	—	1,109,089	—	—	—	1,109,089
Sewage[3]	168,157	75,775	75,775	—	—	—	319,707
Telephones ...	—	—	—	—	—	12,096	12,096
Electricity	—	—	—	—	32,759	—	32,759
Mail	—	—	—	—	—	118,606	118,606
Schools	—	314,284	—	—	—	—	314,284
Travel to Work, etc.[4]	—	—	− 2,231	—	—	—	− 2,231
Miscellaneous Transport[5] ...	− 258	− 2,844	613	—	—	—	− 2,489
Housing[6]	198,740	—	138,544	—	—	—	337,284
TOTAL ...	366,639	457,397	1,391,972	638,044	32,759	130,702	3,017,513

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TABLE V.4

Area D Relocated (£)

	Atcham R.D.C. (1)	Salop C.C. (2)	Central Gov't.* (3)	W.S. W.B. (4)	Midlands Elect. Board (5)	G.P.O. (6)	Total Cost to Public Bodies (7)
Water Supply[1] ...	—	70,182	70,182	590,624	—	—	730,988
Agriculture[2] ...	—	—	1,249,378	—	—	—	1,249,378
Sewage[3]	160,299	76,825	76,825	—	—	—	313,949
Telephones ...	—	—	—	—	—	10,993	10,993
Electricity	—	—	—	—	34,293	—	34,293
Mail	—	—	—	—	—	115,530	115,530
Schools	—	313,897	—	—	—	—	313,897
Travel to Work, etc.[4]	—	—	− 12,027	—	—	—	− 12,027
Miscellaneous Transport[5] ...	− 809	503	61	—	—	—	− 245
Housing[6]	287,290	—	230,283	—	—	—	517,573
TOTAL ...	446,780	461,407	1,614,702	590,624	34,293	126,523	3,274,329

TABLE V.5

Areas B + C Relocated (£)

	Atcham R.D.C. (1)	Salop C.C. (2)	Central Gov't* (3)	W.S. W.B. (4)	Midlands Elect. Board (5)	G.P.O. (6)	Total Cost to Public Bodies (7)
Water Supply[1] ...	—	70,182	70,182	444,614	—	—	594,978
Agriculture[2] ...	—	—	1,273,808	—	—	—	1,273,808
Sewage[3]	135,785	77,175	77,175	—	—	—	290,135
Telephones ...	—	—	—	—	—	7,543	7,543
Electricity	—	—	—	—	29,079	—	29,079
Mail	—	—	—	—	—	93,919	93,919
Schools	—	278,043	—	—	—	—	278,043
Travel to Work, etc.[4]	—	—	− 16,698	—	—	—	− 16,698
Miscellaneous Transport[5] ...	− 981	− 7,687	1,704	—	—	—	− 6,964
Housing[6]	648,660	—	537,644	—	—	—	1,186,304
TOTAL ...	783,464	417,713	1,943,815	444,614	29,079	101,462	3,720,147

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TABLE V.6

Areas B + D Relocated (£)

	Atcham R.D.C. (1)	Salop C.C. (2)	Central Gov't.* (3)	W.S. W.B. (4)	Mid-lands Elect. Board (5)	G.P.O. (6)	Total Cost to Public Bodies (7)
Water Supply[1] ...	—	70,182	70,182	396,968	—	—	537,332
Agriculture[2] ...	—	—	1,414,097	—	—	—	1,414,097
Sewage[3]	128,703	77,700	77,700	—	—	—	284,103
Telephones ...	—	—	—	—	—	6,441	6,441
Electricity	—	—	—	—	31,014	—	31,014
Mail	—	—	—	—	—	87,324	87,324
Schools	—	278,043	—	—	—	—	278,043
Travel to Work, etc.[4]	—	—	− 24,839	—	—	—	− 24,839
Miscellaneous Transport[5] ...	− 1,533	− 7,405	2,219	—	—	—	− 6,719
Housing[6]	737,210	—	629,383	—	—	—	1,366,593
TOTAL ...	864,380	418,520	2,168,742	396,968	31,014	93,765	3,973,389

TABLE V.7

Areas C + D Relocated (£)

	Atcham R.D.C. (1)	Salop C.C. (2)	Central Gov't.* (3)	W.S. W.B. (4)	Mid-lands Elect. Board (5)	G.P.O. (6)	Total Cost to Public Bodies (7)
Water Supply[1] ...	—	70,182	70,182	543,425	—	—	683,789
Agriculture[2] ...	—	—	1,293,003	—	—	—	1,293,003
Sewage[3]	146,614	76,825	76,825	—	—	—	300,264
Telephones ...	—	—	—	—	—	9,534	9,534
Electricity	—	—	—	—	33,581	—	33,581
Mail	—	—	—	—	—	101,923	101,923
Schools	—	313,897	—	—	—	—	313,897
Travel to Work, etc.[4]	—	—	− 14,258	—	—	—	− 14,258
Miscellaneous Transport[5] ...	− 1,067	− 2,341	674	—	—	—	− 2,734
Housing[6]	486,030	—	368,827	—	—	—	854,857
TOTAL ...	631,577	458,563	1,795,253	543,425	33,581	111,457	3,573,856

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TABLE V.8

Areas B + C + D Relocated (£)

	Atcham R.D.C. (1)	Salop C.C. (2)	Central Gov't.* (3)	W.S. W.B. (4)	Midlands Elect. Board (5)	G.P.O. (6)	Total Cost to Public Bodies (7)
Water Supply[1] ...	—	70,182	70,182	350,045	—	—	490,409
Agriculture[2] ...	—	—	1,457,722	—	—	—	1,457,722
Sewage[3]	115,931	78,050	78,050	—	—	—	272,031
Telephones ...	—	—	—	—	—	4,984	4,984
Electricity	—	—	—	—	26,090	—	26,090
Mail	—	—	—	—	—	78,928	78,928
Schools	—	278,043	—	—	—	—	278,043
Travel to Work, etc.[4]	—	—	− 27,070	—	—	—	− 27,070
Miscellaneous Transport[5] ...	− 1,791	−10,249	2,832	—	—	—	− 9,208
Housing[6]	935,950	—	767,927	—	—	—	1,703,877
TOTAL ...	1,050,090	416,026	2,349,643	350,045	26,090	83,912	4,275,806

* Excluding G.P.O.

Notes:

1 Initial construction costs are shared among the W.S.W.B., Salop C.C. and Central Government in accordance with the maximum grants payable under the provisions of the Rural Water Supplies and Sewerage Acts. All other costs (including connection of properties to mains) are included in the W.S.W.B's. figure.

2 Farm subsidies.

3 Allocated, as in the case of water supply, in accordance with the Rural Water Supplies and Sewerage Acts.

4 Increase in tax receipts due to increase in vehicle mileage. (Data estimated mainly from A.A. pamphlet, '*Schedule of Estimated Running Costs*' *op.cit*, adjusted in the light of subsequent Budgetary changes, and used in conjunction with the data on vehicle mileage and car size listed in Chapter 13.)

5 Savings accrue to Atcham R.D.C. (refuse collection) and, in all cases but D, to Salop C.C. in respect of medical services, libraries and school transport. This would be felt partly as a reduction in Central Government tax receipts due to the fall in vehicle mileage. Tax receipts would also fall as a result of a reduction in mileage covered by (privately owned) mobile shops, etc. Costs and receipts calculated from estimates of vehicle mileage and fuel consumption under the various headings listed in Chapter 14.

6 The cost of new housing, *less* the cost of connection to water and electricity, is given in Column (1). (Costs of connection to these services would in fact probably be met by Atcham R.D. but they are already included as expenditure by the appropriate authorities.) The value of abandoned domestic properties is given in Column (2): it is therefore assumed that the Central Government would pay compensation of this value to displaced householders. No estimates are made of the savings that would be achieved by relocation in respect of house improvement grants. No estimates are made of compensation for farmers who abandon agricultural property: the net increase in profitability of farm land in the area would tend to compensate the displaced farmer to the extent that he would be able to obtain a price for it that would be higher than the present worth of its annual net value to him in its present use.

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Certain difficulties arose in allocating costs among the various public bodies listed in Tables V.1 to V.8. This applied in particular to housing; the reason for this is that in the absence of any precedent for such a policy, we could not predict who would in fact be the responsible authority for paying for the new housing or for compensating displaced householders.[1] Similarly, other inter-public authority transfers (taxes and subsidies paid or received by the public bodies listed) will not have been accurately allocated. For this reason, column (7) of each of the preceding tables provides estimates of the total budgetary cost to *all* public authorities for each sector of activity.

[1] Moreover, at this stage, the precise amount of compensation cannot be predicted, but it is safe to say that if all properties were to be abandoned the market value would be very much a *minimum* estimate of the sum required to induce their occupiers to leave.

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MINISTRY OF HOUSING AND LOCAL GOVERNMENT

THE SOUTH ATCHAM SCHEME

An Economic Appraisal

Report submitted to the
Minister of Housing and Local Government
by J. J. Warford

Faculty of Economic and Social Studies
The University of Manchester

LONDON
HER MAJESTY'S STATIONERY OFFICE
1969

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Important

This study was commissioned, as the foreword makes clear, by the Minister of Housing and Local Government; but the approach adopted and the opinions expressed in the report are the author's and do not commit the Government.

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Foreword

Acknowledgement and Synopsis

This study was commissioned by the Ministry of Housing and Local Government, with the object of finding out how far economic analysis could help to identify and measure the costs and benefits of providing mains water supplies in remote rural areas. As a pilot study, a currently proposed scheme, covering a rural area immediately to the south of Shrewsbury, was selected for intensive evaluation.

The work which forms the substance of this report was carried out between August, 1967 and July, 1968. For part of this time I was assisted by Mr. S. Holden of the Ministry of Housing and Local Government, who carried out the travel survey and assisted in many other respects. The study could not have been completed without the conscientious help provided by officials of the following organisations:

Atcham Rural District Council
Birmingham and Midland Motor Omnibus Company
G.P.O. (Head Post Office, Shrewsbury)
G.P.O. (Shrewsbury Telephone Area)
G.P.O. (West Midland Telephone Area)
Midlands Electricity Board (Shrewsbury District)
National Agricultural Advisory Service (Shropshire)
Road Research Laboratory
Salop County Council
Valuation Office, Inland Revenue
West Shropshire Water Board.

Throughout the study I also had the benefit of constant help and advice from Mr. A. G. Rayner, of the Ministry of Housing and Local Government, Mr. Alan Williams, Director of Economic Studies at H.M. Treasury Centre for Administrative Studies, and other officials of the Ministry of Housing and Local Government and of the Management Accounting Unit of H.M. Treasury. I am deeply grateful to them all. Finally, my thanks are due to Professor A. R. Prest and Dr. R. Millward of the University of Manchester, who have read and commented on parts of the work, and to Mr. B. Peart of the Ministry of Agriculture, who spotted (and enabled me to correct) an important error in my original analysis of the effects on agriculture.

The report itself covers the following ground:

Chapter 1 summarises official water supply policy which aims to ensure that as many houses as possible can readily be connected with a public main. It is pointed out that attainment of this goal in the case of rural localities involves successively higher costs as the areas concerned become more remote, so the question has arisen as to whether or not it is time to call a halt to this process. The object of the present exercise is to devise procedural rules that are of general application to the appraisal of rural water supply projects, by conducting a

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pilot study and applying the technique of cost-benefit analysis to a particular project, that designed to serve the southern part of Atcham Rural District in Shropshire. This involves identifying all the costs (and benefits) of providing access to public water mains, whether met by (or accruing to) private individuals, public bodies, local or central government. Costs are defined so as to cover the use of all resources which have alternative uses, but exclude transactions which are merely transfers of purchasing power from one group in the community to another. This takes the study beyond the narrow field of water supply, into a wide range of consequential effects upon other public services and upon the general pattern of economic activity in the study area.

Chapter 2 sets out the main physical characteristics of the study area, which covers some 42 square miles of Atcham R.D. immediately to the south of Shrewsbury and has 1,100 properties, 682 of which are as yet unserved with mains supplies (see Map 1). The most significant physical characteristic of the area is the rapid transition from lowland country to foothills and moorland, which suggests that although the area as a whole may not be typical of those regions still without mains supplies, part of it is probably very typical. The remainder of the chapter briefly describes the planned water supply scheme, although this, and the nature of the study area, are described in more detail in subsequent chapters.

Chapter 3 examines the benefits of mains water supplies under three headings: (a) Domestic Use, (b) Commercial and Industrial Use, and (c) Fire Fighting, with a view to discovering whether the benefits exceed the costs. As regards domestic use, since individuals clearly obtain some water, the important difference between the existing and the proposed supplies is one of quality. This raises the question of public health, but although it is clear that the bacteriological quality of private supplies in the area is poor, there is no statistical evidence of any adverse effects on people's health. The vagueness surrounding the potential danger to public health of private supplies is unsatisfactory, particularly as public health considerations appear to be the main reason for pressing on with costly water supply projects in ever more remote areas. Thus, if it is reasonable to expect public health authorities to be in a better position than individual consumers to judge the danger to health of these private supplies, it is also reasonable to ask them to be more precise in their estimation of the risks that are entailed. The first conclusion of the present exercise therefore is that the fundamental assumption regarding the necessity of providing mains supplies to all consumers should be more rigorously investigated. Because of the uncertainty concerning public health we have had in this exercise to conform to official policy in accepting the constraint that households in the study area must be given the opportunity to be served with mains supplies, and the 'do nothing' solution is therefore rejected. This leaves only one major alternative to taking water to people, namely, moving people to water. This would provide a benchmark by which the net social cost of the scheme originally planned can be evaluated. As regards commercial and industrial water use, the benefits can be measured as the value of the net increase in output resulting from the scheme. In the South Atcham area virtually the only such activity is agriculture, which is considered in more detail later. As regards fire fighting, it appears that insurance companies do not usually charge additional premiums for properties without mains supplies, the implication being that the additional fire hazard is negligible.

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Since the only alternatives that are being appraised here all involve the provision of mains water supplies for all properties, this aspect can safely be neglected, but it would need closer scrutiny if the 'do nothing' solution were to be treated as a serious alternative.

Chapter 4. In order to study the two broad alternative courses of action, viz., supplying piped water to people in their existing locations, or relocating people in concentrated settlements more convenient for water supply purposes, it is necessary to specify relocation sites. In so doing we have imposed the constraint that everyone remains within the study area, and that the sites selected should be ones from which it would not be unreasonable to expect individuals to continue to work where they do at present. The study area falls conveniently into four Areas for water supply purposes, these being designated A, B, C and D (see Map 2). The effects of relocation were examined for Areas B, C and D separately and for all possible combinations of them, it being clear that if mains supplies were provided at all, Area A would certainly be served. This meant that seven alternative calculations needed to be made, referring respectively to the depopulation of the following Areas: B, C, D, B + C, B + D, C + D, B + C + D. The eighth possibility is, of course, to supply everybody in their existing locations. The repercussions of relocation are clearly vast, and in the following chapters not only are the effects on water supply costs examined, but also those on sewerage, education, mobile libraries, electricity supply, telephones, housing, health and welfare services, mail, passenger transport, refuse collection and travelling shops, as well as agriculture.

Chapter 5. In presenting the results it is usually convenient to estimate the present worth (over a 30 year period) of the costs of various activities should the existing settlement pattern be retained, and to estimate separately the corresponding costs for the relocation situations. In some cases, however, it is found more convenient to estimate directly the differences between the two (i.e. ignoring any costs that are common to both). Where possible, the costs estimated for the relocation alternatives are based on the assumption that the same standard of service is provided as with the existing settlement pattern. Repercussions outside the study area are ignored, and no account is taken of the possibility of future housing development in the area.

Chapter 6 deals with the costs of the actual water supply schemes for each of the eight alternatives, the absolute capital costs of mains being set out in Table 6.1 and the savings from each of the seven relocation cases in Table 6.2. Connection costs (on the assumption that everyone in the area connects) are set out in Table 6.5. In fact, 93 of 356 domestic properties in the area which already have the opportunity to connect to mains supplies have not done so, but since the object of the present exercise is to find out how much it would cost to meet the absolute constraint imposed by the public health risk, we are logically bound to estimate the costs of connecting all households to the mains. Replacement costs of pumping equipment are set out in Table 6.7 and, when the running costs of the system are added, the overall year-by-year costs are set out in Table 6.8.

Chapter 7 examines the impact upon agriculture of each of the eight alternatives. For consistency, the public health constraint must be applied to the occupiers of farms as for everyone else, and it must therefore be assumed that

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if water is not provided in the existing locations, the farmers must move. This creates problems for farm management, in that certain types of production could no longer be carried on. In placing a value on these changes, since the study is concerned only with real (social) costs and benefits, in terms of the value of resources used up and goods produced, the real benefits are taken to be the market value of the relevant output, and the real costs are taken to be the unsubsidised costs. On the cost side, payments for farmers' labour are imputed, based generally on what it would cost to hire farm managers to run each farm. Taking first of all the case where water is supplied to existing locations, it is assumed that the pattern of activity will be the same as it is now, since the current availability of private water supplies and the type of farming land to be found in the region suggest that changes would be negligible. For Area B, the social net value of existing output is estimated to be about *minus* £64,000 per annum (i.e. the unsubsidised value of the inputs *exceeds* the market value of the output by this amount), although farmers' profits are estimated to be about £13,000 p.a. If all residential properties in Area B were relocated, then after the consequential adjustments in farming activities in that area the social net value of output would be minus £28,000 p.a., an improvement of about £36,000 p.a., while farmers' profits would rise by about £15,000 p.a. to £28,000 p.a. However, the reorganisation of farming consequent upon relocation would make over half the present agricultural labour force in Area B redundant. One set of calculations is made on the assumption that immediate re-employment is possible, but if a redundant worker *cannot* obtain alternative employment, his current employment involves no opportunity cost. As an alternative, therefore, the study postulates that one-third of the redundant workers obtain re-employment within the same year, one-third the following year and the remaining one-third the year after that. This raises the net social value of existing output, because some of the labour costs are now set at zero, raising the current social net value by about £19,000, and in the next year by half that amount. A further minor complication is that there will be a once-and-for-all expenditure on new buildings or on conversion of old ones at the time of relocation, which was not picked up in the earlier estimates of annual costs and which is estimated at £50,000 for Area B. Similar calculations are made for Areas C and D, and all the figures are converted to present values at alternative discount rates of 6%, 8%, 10% and 12%. The effects of relocation on farmers' profits (all favourable) are thus shown in Table 7.25, and the effects on the net social value of output (or rather its net social *cost* since the 'values' are all negative) are shown in Tables 7.27(A) and 7.27(B). The general pattern is that at all four discount rates each relocation alternative would reduce the net social cost of maintaining agriculture in the area.

Chapter 8 considers the repercussions of providing water upon the need for improved sewage disposal facilities. For fairly isolated properties, septic tanks are assumed to be an adequate solution if built to certain specifications and emptied regularly. For all concentrated settlements, including all relocation sites, main drainage has been assumed to be necessary. Two main drainage schemes are already planned for Area A, so these should not be treated as an additional cost resulting from relocation. The relocation alternatives, therefore, show a net benefit in terms of sewage disposal costs (Table 8.4), whereas if the main drainage schemes had had to be created from scratch to deal with the requirements of the relocation sites, they might well have imposed net costs.

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Chapter 9 indicates that although relocation would reduce the costs of telephone services (by more than half if Areas B + D or B + C + D were relocated), the absolute sums involved are relatively small. Thus, in the latter case the savings are only about £10,000 in present value terms even at a 6% discount rate.

Chapter 10 examines effects on electricity supply costs, and here the conclusion is that total relocation (i.e. depopulation of Areas B + C + D) would yield present value equivalent savings of about £12,000 using a 6% rate, but that this saving falls sharply as the discount rate rises and, in fact, disappears with a 12% discount rate. All partial relocation solutions are more costly than total relocation, and usually more costly than supplying people where they are now (Table 10.7).

Chapter 11 deals with the savings generated by relocation in terms of vehicle mileage, staff time and other sundry expenditure associated with G.P.O. mail services. Here, both the absolute sums involved and the savings from relocation are much greater than in the two preceding cases, the total relocation alternative, for instance, saving over £4,000 p.a. which is £70,000 in present value terms at 6%, or £36,000 at 12%, and which works out at about £16 p.a. per relocated household.

Chapter 12. The effects of relocation on the capital and running costs of schools in the area are estimated and summarised in Table 12.5. The general picture is that the depopulation of Area C (by itself or in any joint relocation scheme) would have no effect on school costs, and depopulation of Area D has only a very minor impact. The major savings occur if the inhabitants of Area B are relocated. These costs do not include the costs of travel to school, which are dealt with in Chapter 14.

Chapter 13 presents estimates of the repercussions of relocation on the cost of conveying individuals to work, shops and places of entertainment, and of farmers' journeys to market. All such journeys are made by road in this area, so the estimates relate to travel by private car and by bus, and include both vehicle operating costs and the value of time spent travelling, on the assumption that the same mode of transport continues to be used. Journeys to work are affected in the first two years by the assumptions made about the re-employment lag, hence two sets of calculations are provided to take account of this complication. The other complication concerns the valuation of non-working time spent travelling. Two different assumptions are employed here: first, the value of non-working time is taken as three-quarters of the value of working time; and secondly, non-working time is valued at zero. Separate estimates are made for each of these cases, all four possibilities being summarised in Tables 13.23(A) to 13.23(D). It should be noted that here only the *extra* costs of relocation have been estimated and they vary (in the full relocation alternatives) from a present value of about £45,000 under the most favourable assumptions (high discount rate, two year re-employment lag and non-working time valueless) to nearly £175,000 under the least favourable (i.e. the opposite) assumptions. These substantial sums are mainly accounted for by the extra journeys made by farm workers as a result of relocation, which are only slightly offset by the savings of others.

Chapter 14 covers other miscellaneous transport effects, including those on health and welfare services, libraries, refuse collection, school transport, mobile

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shops and miscellaneous deliveries, and on farm suppliers, assuming no change in the standard of service. Road construction and maintenance are also briefly discussed, but these effects appear to be insignificant and have not been estimated. Roughly half of the total savings from relocation shown in summary Table 14.6 are due to the effect on school transport facilities (except for Area D, where such costs rise) and most of the remainder are explained by savings in journeys made by mobile shops. Effects on other services are relatively small, as indeed, in relation to the transport effects considered in the preceding chapter, are the overall cost savings that relocation would involve, these always being less than £25,000 in present value terms.

Chapter 15 deals with the important subject of housing. Relocation involves the abandonment of some existing dwellings, and it has been assumed that their present worth in existing uses is approximated by their market value, and that this is an adequate measure of the loss in real terms. Rehousing the displaced population would then involve additional costs in constructing the necessary residential properties. These costs would have as their counterpart the present worth of the benefits provided by the properties in question, and this is assumed to be equal to their costs. The *net* cost of relocation, in housing terms, is therefore taken to be the market value of abandoned properties (with some minor adjustment to take account of differential private travel costs). Market values were estimated directly for a sample of all affected houses and three estimated values are given, the mean value ($\bar{x} = \mu$), the *upper* bound of the 95% confidence limit ($\bar{x} > \mu$) and the *lower* bound ($\bar{x} < \mu$). The adjustment for privately borne travel costs is affected by the assumption made about the value of non-working time, so there are two variants of each of the above, making six variants in all, as shown in Tables 15.10(A) to 15.10(F). Under the most favourable assumptions (i.e. 12% discount rate, *lower* bound housing valuation, non-working time valueless), the present value of the cost of abandoning all houses in the study area is about £675,000. At worst it is over £900,000.

Chapter 16 brings together all these calculations for each relocation pattern in 32 'present value' tables, one for each possible combination of the various alternative assumptions that have been made (i.e. two concerning the re-employment lag; two concerning the value of non-working time; and two concerning housing values—upper and lower bounds only), with eight such tables for each of the four discount rates used. These are Tables 16.1 to 16.32. Then, in Tables 16.33 to 16.36, the net benefits of each relocation pattern are given (i.e. the *cost savings* from each relocation alternative *as compared with* leaving people where they are). With discount rates of 6% or 8%, relocation is cheaper in all cases. With a 10% discount rate relocation alternatives C, D and C + D cease to be always cheaper than leaving people where they are but only with one combination of assumptions: viz., abandoned houses at maximum value, high value on non-working time and the two-year re-employment lag. With a 12% discount rate this combination of circumstances shows the balance of advantage to be against all relocation alternatives and, so long as the maximum value for housing is retained, the other two assumptions can be relaxed and still some relocation alternatives would be rejected (especially C, D and C + D). However, the maximum margin in favour of relocation is over £700,000 whereas the maximum in favour of supplying people where they are is less than £70,000. It will also be noted that in all cases there are 'economies of scale' to

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be derived from the relocation alternatives, e.g. the savings accruing from B + C exceed those from adding the savings from B alone to those from C alone. Quantitatively, the most important factors affecting the outcome for South Atcham are the savings in water supply costs, the reduction in the net social cost of agricultural production and the value of abandoned houses. Because of differences in the time streams, the outcome is highly sensitive to the discount rate, but not very sensitive to the assumptions about re-employment or the value of travelling time.

Chapter 17 points out that in most of the circumstances envisaged in the foregoing analysis, relocation would be preferable to the water supply scheme so far as the quantified factors are concerned. The decision maker would, however, have to consider the likely margin of error in the estimates, and also intangible factors not quantified in the report, and weigh these in the balance. It is quite possible that relocation would not then show a net social benefit of sufficient magnitude to warrant any dramatic change of policy as far as the South Atcham scheme itself is concerned. But South Atcham is rather more densely populated than many areas as yet not in receipt of mains supplies, agricultural patterns vary, as does the proximity of large towns as centres of employment. Thus, if the same method of analysis were applied in other areas the results might indicate quite clearly that the costs of maintaining the existing settlement pattern would exceed those incurred in providing similar facilities by relocation. It is suggested that since the objective of current policy is to give people the *opportunity* to connect to mains water supplies (despite the health hazard they are often not *compelled* to do so), then if relocation really shows a net social benefit people could possibly be encouraged to move by being offered compensation equal to the market value of their homes plus a removal grant. The size of the removal grant would be partly a matter of equity, but an upper limit could be set equal to the total savings from relocation compared with the proposed water supply scheme. It may nevertheless turn out in rare situations that the incidence of acceptance and rejection of the rehousing grant in an area produced the awkward situation in which the net cost of providing services (except water) for existing properties that remain inhabited, plus services (including water) to the relocation sites, could be greater than the net cost of providing all services for the existing settlement pattern. The rehousing offer would, in those circumstances, have to be withdrawn. Among the intangible effects of relocation not discussed in the present exercise are the costs or benefits of relocation in terms of visual amenity, impact on the 'rural way of life', etc. Moreover, certain possible options, that might meet the postulated health hazard equally effectively, have not been systematically appraised in this study. Among these are the improvement of sewage disposal facilities so as to reduce contamination of existing water supplies to tolerable levels, or local treatment of the existing water resources themselves. Full-scale cost-benefit analysis of the kind used here could be employed to appraise these additional options. For situations similar to South Atcham, where the policy option is as postulated, a streamlined method of analysis is suggested which would restrict the initial appraisal to the three major factors involved, viz. the value of abandoned properties, the cost of the proposed water supply scheme and the impact upon agriculture in the area.

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Map 1

Map 2

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